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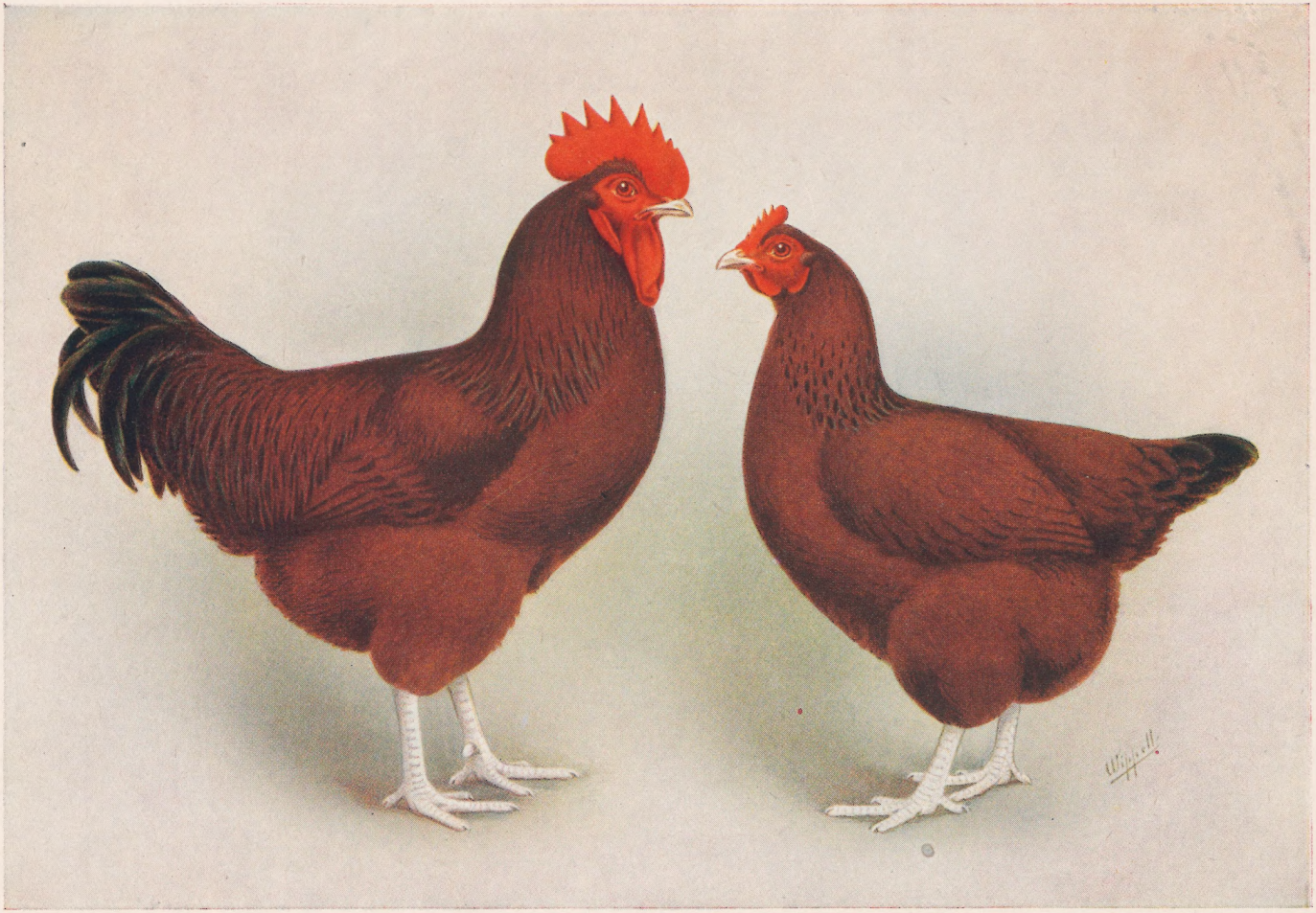
VOL. II



RED SUSSEX FOWLS
(Bred by Mrs. Morris, Blewburton Hall, Aston Tirrold, Berks.)
Male: First Prize at Royal Show; Champion Sussex, Edenbridge, etc.
Female: First Prize and Special, Birmingham Club Show, etc.

POULTRY

BREEDING AND PRODUCTION

By EDWARD BROWN, LL.D., F.L.S.

President of The World's Poultry Congresses 1921, 1924, 1927; Honorary Past President of the International Assoc. of Poultry Instructors and Investigators; First President of the National Poultry Council (England and Wales).

VOLUME II

THE LINES OF DEVELOPMENT

NEW YORK

JOHN WILEY & SONS, INC.

1929

BALCONY
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E 6669

(Made and Printed in Great Britain)

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2 BROKEN-SPAN LAYING SHED

3 PORTABLE FARM OR COLONY HOUSE

4 COMPARTMENT LAYING HOUSE

5 EXTERIOR ELEVATION OF PLANS 1, 2 AND 4

6 INCUBATOR SHED

7 BROODER HOUSE

8 HOUSE FOR GROWING STOCK

9 FATTENING SHED

10 EXTERIOR ELEVATION OF PLANS 6, 7 AND 9

CHAPTER XVI

THE LINES OF DEVELOPMENT.

CHAPTER XVI

THE LINES OF DEVELOPMENT.

THE BASIS OF PROFIT—VARIABILITY OF POULTRY HUSBANDRY—EXTENSIVE OR INTENSIVE—RELATION OF POULTRY TO CULTIVATION—DESTRUCTION OF PARASITES—MANURIAL VALUES—SPECIALISED POULTRY INDUSTRIES—DISTRICT INDUSTRIES—BREEDING FARMS—EGG FARMS—URBAN AND SUBURBAN POULTRY-KEEPING.

"Profound wonderment has been expressed at the creation of great national industries based upon the humble hen. Poultry are of comparatively small unit values. In the aggregate they are exerting influences which have practically few limitations. The keeping of poultry is within the sphere and scope of almost every section of the people of all nations.

"The distribution of poultry as a result of migration of people, of conquest, of intercourse, and of commerce, and also a craving for sport or for higher standards of living, have made for advancement. Some of these influences have been most potent within the last century. In later decades there has been an ever increasing pressure in respect to food supplies, in itself a potent influence. To the changes here indicated nature has been wonderfully responsive. Broad, and deep, and wide spread are the foundations of modern poultry husbandry. At our disposal is the inherited accumulation of the wisdom and experience of the ages. Throughout many areas of Europe, Asia, and Northern Africa poultry breeding and production have been practiced for from 2,000 to 3,000 years, and with a considerable degree of what may be termed the scientific spirit. Some of the much-heralded methods which have been widely adopted within the last generation,

claiming to be new discoveries, are merely revivals of what was known long ago. This fact is not mentioned to minimise the service of those who have rediscovered such systems. It is to indicate that there are vast reserves of knowledge yet to be drawn upon, possibly where we least expect to find them." (1).

The growth of egg and poultry production on business lines in nearly all countries over the entire globe within the present century has been remarkable. Only those who by continuous observation have had an opportunity of noting the progress made can form any conception of the changes that have taken place. Frequently small in the individual case, it is enormous in the aggregate. The evidences are everywhere apparent that a great advance in poultry-keeping on what are commercial lines—by which is meant that food-production is the chief object, as distinct from amateurism, breeding for pleasure or exhibition, or a side issue on farms, which at one time were the dominant branches—as these are still to some extent—has been made. The greatest development has taken place within recent years in those countries where industrial and commercial advance has been greatest, due to the pressure of demand for food. In others progress has not been to the same degree. There is no country of which we have knowledge where poultry husbandry is incapable of great development, which fact is being recognised. In addition are the unoccupied areas of land waiting to be settled, most of all in the newer countries of the globe. Everywhere the human factor is of supreme importance. Poultry require, and must have, land on which to grow and live, from which to obtain part of their nutrition. Land, however, is useless for this class of stock unless it is occupied by a settled population. Great though the progress made has been, it is small as compared with the possibilities, both in the occupied and unoccupied areas. In that respect the question of profitable markets for sale of produce is a determining factor.

The Basis of Profit.—The term "poultry-keeping" expressed what had been largely true in the past, with exceptions as noted in the following pages. In too many cases the owners "kept" the fowls, literally as well as morally. Poultry were regarded as a non-economic section of live stock. Little attempt was made to deal with them as other classes of farm animals, in which productiveness relatively to

White Leghorn Pullets in Orchard
(Messrs. John Chivers & Sons, Ltd., Histon, Cambs., England, who combine Fruit Cultivation and Poultry Farming)

costs was kept prominently in view. Those who adopted more progressive ideas were mainly amateurs, whose operations could be no more profitable than is an ornamental garden or conservatory. The vast majority of poultry were non-commercial. The old saying that "poultry don't pay" was true when applied to these conditions. There were, however, abundance of instances of individuals and of districts in different countries by which the falsity of this axiom could be proved. There it was evident that, given good conditions and right methods, more especially in association with cultivation in one form or another, poultry were profitable to an extent equal to, if not to a greater extent than, any other branch of domestic livestock. In the main it was necessary to adopt a complete change of methods and ideals. Such has been to a considerable extent realised. What we have now to aim for is to bring about that alteration of system which will make poultry husbandry commercial in the true sense, so that it may be profitable and afford opportunities for workers of all grades. An object of the present work is to indicate what has been and is being done, and the line of future development in the light of such experience as is available.

Variability of Poultry Husbandry.—As indicated above a great change has come over the scene. The approach to this question is totally different to what was formerly the case. Much of the indifference on the part of public authorities, and antagonism on that of certain interests, have passed, and there is hearty co-operation. Most of all farmers, who have been slow to awaken to neglected opportunities, are coming to realise that poultry can be made the most profitable branch of live stock, if given adequate and continuous attention on the best lines. In nearly every country the great bulk of supplies of eggs and poultry have been derived from farmers, which is likely to continue to a greater extent. They have not, however, given attention to production and marketing, except in a few countries, with the consequence that there has been great loss in quality followed by depreciation in returns. Although the opportunities for increased numbers of poultry kept by farmers are very great in almost all lands, one of the primary considerations should be improvement of quality by adoption of better methods.

The most important advance made during the present century has

been in the development of poultry farms conducted on commercial lines, in which eggs and poultry form the chief object and source of profit. Many attempts were made during the latter half of the Nineteenth Century to attain success in this direction. Except where the sale of breeding stock, eggs for hatching, etc., was associated with, generally the main source of income, production for market, these failed, in some cases disastrously. That was true in all countries. Such has been completely changed. Commercial Poultry Husbandry has abundantly proved that production for market can be made profitable as a partial or entire living, where there are skill, enterprise, energy wisely directed, and good outlets for the produce are available, together with adoption of business methods. The change referred to is the result of many influences. Most notable are increased productivity on the part of laying hens, as a result of selective breeding, more effective management, diligence, better housing and feeding, and enhancement of prices for eggs and poultry, so that the returns are sufficiently high to meet the increased costs inseparable from adoption of specialist methods. There is much, however, yet to be learnt, chiefly in the direction of economy of labour, in prevention of disease, and by making the standard of life conform to the profits of the enterprise. Capital for the necessary equipment is essential, whether that be available at the commencement, or is created gradually. Some of the most prosperous poultry farmers began operations on a very small amount of money. They were content during the formulative period to work hard and live simply, denying themselves for the time being of much that has come to them with the achievement of success. That there have been not a few, as in every pursuit, who have failed is unquestionable. Our difficulty has been to restrain those who, from excess of imagination, plus want of experience, have taken up this pursuit, knowing little or nothing of what is involved, and, maybe, seeking for an easy mode of money making. Poultry Husbandry must either be a part of general farming, or a highly specialised business demanding constructive qualities and wide experience, and should not be undertaken by anyone who desires to live by it without a thorough training of the most practical character, together either with other means of livelihood or sufficient capital for establishment and carrying over the initiatory period. What is here stated also applies

to the establishment of breeding farms to an even greater extent.

In addition to the two classes stated are the great host of those whose operations are limited, some of whom desire to extend later. These include exhibition breeders, amateurs, cottagers in rural areas, suburbanites and denizens in our great centres of population. It is a fact that the number of people who are interested in one or other branch of poultry culture is greater than in any other field of human endeavour.

Extensive or Intensive.—There are two schools of thought in respect to this branch of natural science—for science it is—namely, those who believe the future of poultry husbandry to be on extensive lines on the one hand, and those who pin their faith to intensive methods on the other. Both these systems have their place, as have others that are midway between the two. These, however, only differ in degree. The basal principles must be the same. For food-production the extensive method—that is, as part of general farming—is the main source of supply. And, further, as a question of profit, the costs are lower on farms than on special plants, so that the interests of consumers can be regarded, and foreign competition successfully met. Specialised poultry farms have an important place where there is a large local demand and good prices are obtainable. Intensive methods are merely supplemental and most suited for provision of household supplies.

In the light, therefore, of what has already been stated, and of experience as to demand and opportunities in each district, may be considered what can be done. Great though the advance made during the last generation, it is only a beginning. It may be, and is necessary to revise our methods, to adopt new ideas when these have been proved, and to abandon notions long held. What must be done is to build upon tested experience, and to seek for an understanding of Nature's laws as far as these are known, which, if we resist them are bad opponents, and certain to come off conquerors. It cannot be too clearly understood that, whilst there are principles which apply to every form of poultry husbandry, there are others which are peculiar to each. What may be done under one set of conditions, or even in one country, may not be suitable where the environment is totally different. Much loss has arisen as a result of assuming that farm methods may be successful on smaller occupations, and that systems

adopted by exhibition breeders are equally suitable for those whose object is eggs and poultry for market. No pursuit is more diversified than poultry husbandry, and it is complex in the extreme. One further point is to be noted, namely, that individuality is a potent factor in poultry breeding. Factory methods have not justified their adoption. No branch of production save market gardening has proved to the same extent as poultry that it is available for what may be termed a one man plant.

Relation of Poultry to Cultivation.*—Farmers and fruit growers have one great advantage over specialist poultry keepers in that they can distribute the birds over the land, maintaining the balance of nature, which the last named, to their cost, too often ignore. Fowls and all other animals must bear relation in number to the land, and to its cultivation. In this respect there are variations. Upon some soils more can be kept than upon others. What has been abundantly proved is that an excess of animal to plant life is certain to induce disease, as a result of contaminated soil. Plant growth must be the greater. Many of the failures met with, and most of the epidemics which we have seen, have been due to ignoring what is here set forth. On farms where the number of birds kept is small these may be successfully maintained around the homesteads. Unless any increase in number is accompanied by distribution disease is certain to result, as has been abundantly proved in several countries. Not how much land is available, but how it is utilised is the important point. Many examples could be given of the serious losses which have followed the ignoring of what is here stated. For many years we have urged the importance of maintaining the relationship of poultry to cultivation, and of giving as much range as possible so that ground taint may be avoided and natural food obtained. Such advice was ignored. Within more recent years the importance of distribution has been brought home to Commercial poultrymen through the ever-increasing menace of disease. Farmers have learnt by painful experience that concentration of large numbers of birds around the homestead, and upon any one part of the land, in process of time leads to heavy loss whether of old or young stock, and to a serious reduction in the profits. This influence is intensified where the work is carried out on intensive lines. Some of the epidemics which have devastated various countries have been

*Plates LXX and LXXI.

directly or indirectly caused by disregard of what is a natural law, namely, maintenance of a balance between animal and plant life. More serious than the loss as a result of epidemics is the individual mortality of adult stock, the losses met with during the hatching and rearing stages, and the lessened vitality of the birds. Contaminated soil is probably responsible for disease to a greater extent than any other influence.

The great majority of those engaged in Poultry Husbandry, whether as stock breeders or producers, have regarded grass land as most desirable for their purpose. Pastures supply a large amount of green and other natural food. With these there is not the same need for experience in cropping and cultivation of the soil. Exceptions, however, are to be found. Where fruit is the first object, and poultry supplemental—a most profitable combination—the advantages of broken ground are abundantly evident. Those who have adopted the method of poultry-keeping on arable or dug land have been chiefly fruit growers, small occupiers, and cottagers with a limited amount of ground available. Where fowls are "yarded," to use an Americanism, grass becomes coarse and grows in clumps, which are unsightly, and the herbage fails to utilise the manure. Where that is evident it may be regarded as an indication the time has come for removal or change of method.

Observations in many countries have shown that much larger flocks of poultry can be kept on arable land than is generally recognised. The opportunities for extension under such conditions are great. One method which, however, may be applied on grass land is known as the Colony System. By that is meant a portion of the land is thickly occupied by fowls for, say, twelve months, when they are transferred wholly to another part of the farm, when that vacated is cultivated or cropped in the usual manner, determined by whether it is arable or pasture. In this way the manure deposited in the soil is utilised completely, all danger of contamination is obviated, the natural elements in the soil are restored by whatever class of plant life is grown, and after a period the same area may again be occupied by poultry. Relatively a much larger number of fowls or other poultry can thus be kept to the total area.

Fox preservation and other forms of sport have to be taken into

consideration in some countries, specially with regard to adoption of the distributive system. That it has had a most repressive influence in hunting districts is abundantly evident. Frequently, when we have urged upon farmers greater attention to their poultry, they have stated that the loss would be so great, and the bad feeling engendered so considerable, that they did not think it worth their while to run the risk of one or the other. Not a few of those who have made the attempt have had such constant and serious losses in this manner, without receiving any compensation from the hunts, or merely a moiety of what they claimed, and given in the most grudging manner, that they have abandoned the business. Some time ago a prominent farmer in an English Shire publicly stated that the number of poultry on farms could be trebled without material increase of costs were it not for foxes. Some hunts in Britain meet claims for loss of poultry with a measure of fairness, even though the sums received are inadequate. Others either refuse to pay at all, or do so in a manner which rouses animosity. Several poultry farmers have thus been ruined. Hunting men are coming at last to realise that many hunts ought to be stopped, and that this sport can only continue on sufferance. Should the time arrive when the problem of fox hunting in thickly populated countries *versus* poultry husbandry has to be decided—that is, the interests of the few or the many—there can be no question that the last-named must come first, in view of the importance of increasing the national food supply. Poultry farmers are protecting themselves by killing foxes, the number of which will increase. These animals are vermin, and it is within the right of anyone to kill them as a nuisance. The question is of great importance in that the food supplies of the country are reduced to a very serious extent, to say nothing as to the individual losses. Larger farmers may regard the loss of their wives' poultry with equanimity. It is a matter of livelihood to small farmers, allotment holders and specialist poultry breeders.

Destruction of Parasites.—In all forms of cultivation, and especially where intensive methods are adopted, as must always be the case, there necessarily follows a great increase of parasitic life, due to the fact that the food of these minute creatures is increased, and they multiply very rapidly. Nutrition precedes reproduction, and is the determining factor. There are two ways in which this subject may

be approached, first, that parasites prey upon the poultry, reducing their vitality and productivity, often directly causing disease; and, second, the influence upon crops. The former is dealt with later. As to the latter may be quoted a letter from a large farmer (Mr. J. R. Woodhouse) as follows: 'Last spring I planted a field of barley, and it so happened that I did not go near it again for some nine or ten days. When I did visit the field I found that my fowls had been there, and had played such havoc, as I thought, with a portion of the field, that I concluded it would have to be replanted. I, however, was not in a position to do so at once, and before I could make it convenient the barley was up. I then found that this portion of the field was certainly not so thick as the rest. Still, I thought if it should rid, or stool, as it is sometimes expressed, it would do, and therefore I did not interfere with it. It did do so, and I harvested a fair crop. About a fortnight after it came up there appeared unmistakable signs of wireworm in various parts of the field, but no indication whatever of there being any in that portion of the field where the fowls had been at work.' (2) Many other similar cases could be cited.

In orchards the softer nature of the products makes them specially susceptible to parasitic attacks, as a result of which there is frequently heavy loss. The experience of Messrs. Chivers & Son (Histon, Cambs) on their extensive orchards has been that on the larger fruit-trees commonly attacked by the winter moth, it was usual to find fifteen to twenty moths on the grease bands.* Where fowls are in the orchards these are almost entirely cleared, and if any can be traced, they do not at most exceed one or two. It is well known that land planted with strawberries following wheat is often devastated with the crane-fly. The effect of allowing access thereto of fowls prior to the fruit-forming has been to practically clear them of the pest, confirming evidence in America. The raspberry beetle is very destructive to that fruit, and by eating into the buds causes great loss. As many as thirteen have been discovered on a single head. These pests go down the vines in the afternoon or on the approach of stormy weather, when the fowls, if given the opportunity, devour them. On the many acres devoted to raspberries at Histon, the beetle has been cleared by the fowls, to the great gain of the owners. And, finally, there has been no saw-fly on gooseberry bushes where fowls have

*Plates LXX and LXXI.

been run. Here are involved two important factors, namely, the destruction of parasites which increases the output of orchards, and the economy in feeding the fowls thus making them more profitable.

Manurial Values.—There is a further benefit from extensive methods of Poultry Husbandry, namely, the manurial influence, where production is not in excess of the soil's capacity to utilize. One of the most striking examples was found in Belgium prior to the Great War. In that country occupiers recognise the value of manure, of which not a drop or particle seems to be wasted. The fertility of the soil has been greatly enhanced in this manner. The most noticeable instance on a larger scale was in what is known as the Campine district, which extends from the city of Malines east and north to the Dutch frontier. When we first traversed that district it was a dry and sandy plain, covered with fir-trees and incapable of cultivation. During the latter half of the Nineteenth Century poultry breeding was taken up by the peasants of the district on a somewhat extensive scale, primarily the raising of chickens for sale to the fatteners located on the opposite side of the city of Malines. The land was of little use for other purposes. Although there was not much natural food for the birds in the soil, it was dry, and the fir-trees which covered it provided abundant shelter during the hot days of summer, and a moderate amount of insect life was available. Eggs were, as they still are, produced in large quantities throughout this district. On paying a further visit to the Campine country in 1897 already a marked change had taken place. The land near to Malines had been so enriched by manure from the poultry that it had been brought into cultivation. For a distance of about five miles from that city the trees had been cleared, and market gardens for production of asparagus and vegetables took the place of the old woodlands. It was freely acknowledged that the result was almost entirely due to the fowls of which large numbers were maintained.

At the time named around Rymenam, Keerbergen, Putte, and Grasheide in the fir-woods were cottages of a very humble type, attached to each of which were about 12 hectares (nearly 30 acres) of land, with very small clearances, little more than gardens. At one place visited we were informed that the owner had already by the month of June sold 350 birds, and had 400 more for disposal. At

Grasheide was a school-house in the midst of the firs, which came right up to the buildings on all sides. The teacher reared about 4,000 chickens each year. A further visit twelve years later (1909) revealed the fact that the whole aspect was changed. The fir-trees were gone and the land was cultivated. Market gardens, fields in which grain and roots were grown, were found on all sides, owing to the improved fertility of the soil due to poultry during a single generation. (3) Most satisfactory was the higher type of dwelling houses, and the prosperity of the people. What is stated indicates the importance of poultry for improvement of waste lands and uncultivated areas. At the same time similar results have been achieved in connection with general farming where it is necessary to maintain the fertility of the soil. For successful cultivation poultry are invaluable.

Specialised Poultry Industries.—There are several branches of Poultry Husbandry in which there is a large measure of specialisation. To some extent these are general over given areas. It may be assumed that where, for example, egg production is kept mainly in view either the soil and natural conditions are favourable, or there is a lucrative market at hand, or both. The same applies in other directions. It is always wise to study local methods, as these are usually the result of long experience, even though they may be capable of improvement. The breeding, rearing, and preparation for market, of chickens, ducklings, goslings, and turkeys are treated fully in the respective chapters. To summarise it may be stated that as a rule turkeys are kept all their natural life on the place where they are hatched ; therefore that branch is self-contained. Such is not the case with chickens—at least where the finest specimens are produced. The finishing process, known as fattening, is usually distinct from that of hatching and rearing. With respect to ducklings methods vary. In some districts those who keep the breeding stock sell eggs to men who specialise in hatching, rearing and finishing for market. With goslings the rearing and final fattening are usually in separate hands. Dualism has many advantages, distributing the earnings, often leading to greater efficiency, and preventing concentration and monopoly. Of essential importance is that climatic and soil conditions must be favourable to secure the best results.

District Industries.—As already indicated there are several branches

of poultry-keeping which have attained their greatest development over a given area. These are small or large in accordance with local conditions. That is specifically the case with the production on special lines of table poultry. The evidencies are that the success attained is largely dependent upon the system adopted. In connection with egg-production the same is not found to an equal extent, as this is of more universal application to the farms of all sections of the country. For that reason egg-production is more widely distributed. A further factor is that the demand for eggs has grown more rapidly than that for chickens and other poultry, which remain a luxury to many people, whereas eggs form a part of the food in all but the poorest households.

The advantages of uniformity in production are very great, and are conducive to greater success. These may be briefly stated as follows :

1. Reputation counts for much in all departments of trading, and in itself is creative of demand.

2. The force of example and the influence of competition are powerful factors, stimulative of enterprise and making for improvement in quality of any product.

3. Specialised work, such as the fattening of poultry, requires skilled operators, and must be done on a scale affording the men adequate rewards for their labour.

4. Where production in any district is uniform, the sale is greatly simplified, whether that is by means of co-operation or through the ordinary trade channels. Uncertainty and irregularity account for much loss and many failures. Unless the produce of any district is voluminous enough to make handling profitable, except where there is a very large local consumption, prices will be low, by reason of the fact that the relative expenses of distribution are in inverse ratio to the quantity marketed.

5. Under the conditions here set forth, good quality produces much better returns as a result of the reputation already referred to provided that an adequate supply is available.

Breeding Farms.—During the earlier years of the latter half of last century arose breeding farms designed for the purpose of supplying breeding stock, and ultimately eggs for hatching. As demand grew for pure races of poultry these increased in number. At first these

were almost entirely in the hands of exhibitors, or breeders of stock for show. During the later years of the Nineteenth and the first decade of the Twentieth Century, that is, when production began to occupy the dominant position, a large number of poultry farms were established at which special attention was devoted to productive qualities in combination with racial characters. It is not too much to state that the wonderful progress made in several countries has been largely due to those engaged in this branch, who have been the architects of the Poultry Industry. These establishments hold a similar relationship to general poultry breeders as do seedsmen to farmers, and nurserymen to fruit-growers. That they contribute eggs and poultry to market supplies is true, but supplemental to other operations. The main business is of supreme importance to Poultry Husbandry. One of the more recent developments is in the shape of Hatcheries, to which extended reference is made in Chapter XX. No branch has proved more profitable, and not a few owners have made handsome competencies in this manner, whilst others have found an opportunity for enterprise and skill in this field of endeavour, and at the same time have powerfully contributed to the advancement of Poultry Husbandry.

Breeding farms are necessary and occupy an important position. Their success is dependent upon the supplying of stock, or eggs for production of stock, in which the qualities have been developed in a manner impossible to the ordinary farmer or poultryman. The latter have learnt, or are learning, that it will be largely by purchase of what is usually termed pedigree stock, even if he has to pay a good price in doing so, his returns will be enhanced, provided there is maintained a high standard of productiveness. Every encouragement should be given to those who desire to undertake what is an important contribution to Poultry Husbandry. It must, however, be realised that those who enter upon such a pursuit must have the necessary qualifications. Long views, indomitable perseverance, and patience are essentials. Where the work is to be a means of livelihood it should be on a sufficiently generous scale to yield an adequate return. This phase of the industry requires a series of years ere a firm standing is obtainable.

Egg Farms.—For a long period of time attempts were made in the direction of running large farms entirely for egg or chicken production, all of which failed, as we have already seen. In these days of huge

enterprises, of combinations and trusts, the notion of big poultry farms, where laying hens could be kept by thousands, where eggs could be produced by the hundreds of thousands, or chickens turned out by the gross every day when they are most in demand, has fascinated many minds. Flaming accounts were published of such enterprises, generally when only partially in being, expressive of the hopes rather than the accomplishments of the promoters. These forgot, or failed to recognise what Dr. Raymond Pearl has wisely said : ' Chickens are not machines ; they are living creatures. A poultry plant is not a factory. It partakes more of the nature of a girls' boarding school, with a strong leaning on the part of its inhabitants towards suffragette doctrines.' It was not until the stage had been reached when a higher average production of eggs had been attained, and a better understanding of the management and feeding of poultry under such conditions, together with enhancement of values of eggs following upon the Great War, had been reached, that Commercial Poultry Husbandry, as it is now called, could be regarded as an economic proposition. The whole outlook has changed as a result. Those who, as was the case with the writer, did not feel justified in advocating egg farming, on specialised line, and distinct from breeding farms, by reason of the economic factors, gladly recognise the important change which has been brought about, and that a new field of enterprise has been opened, into which many have entered and found success. There are, however, limitations. Of supreme importance is the question of marketing the produce, and of securing the maximum returns. Hence it is that these egg farms have found their opportunity in proximity to residential and industrial areas where a constant and profitable demand is at hand, or where organisation is able to overcome the handicap of distance. There are limitations, however, and dangers not met with under other conditions, which are dealt with in detail in Chapter XX.

One of the most remarkable developments within recent years has been the phenomenal growth of a trade in the sale of day-old or baby chicks, which in America especially has attained enormous proportions. This branch is dealt with in Chapter XX. It may here be mentioned that this system was first brought to notice during a visit paid to France in 1895, where two establishments were visited at which a considerable business was conducted in the sale of chickens hatched in incubators,

and which it was found could be sent long journeys without apparently suffering therefrom. The example thus set was carefully tested. As a consequence the system has grown enormously. Hundreds of millions of these birds are sold annually. It offers a wide field for extension, and has contributed powerfully to growth of the Poultry Industry.

Urban and Suburban Poultry-keeping.—Computation has been made that in some countries which are densely populated, at least one third the chickens and eggs produced are derived from occupations or holdings of less than an acre in extent. It has always been the case that in urban, suburban and industrial districts large numbers of fowls have been kept. During the hey-day of exhibition breeding the majority of those who entered into this pursuit had only back gardens, often back yards, at command. It was their recreation. At the same time the food supplies of their households were increased at a small cost for the reason that scraps that would otherwise be wasted were utilised. The number of birds that could thus be kept in each case was very limited, and it is remarkable what has been done under these conditions. In addition to those who bred for shows were multitudes who placed first the needs of their families. Where gardens were larger in suburban and semi-rural districts more was attempted. Not a few of the most successful poultry farmers began their operations in this way, gradually extending until it became an entire or partial source of livelihood. There has been a steady increase in this field, which is capable of great extension. From the national, as well as the individual points of view, every encouragement should be given, provided there is no danger to public health or nuisance to neighbours, and that hygienic principles are observed. The questions which are involved receive attention in Chapter XXI.

There is one branch of Poultry Husbandry, for in such may be included provision for household supplies, which in this country has not received attention, namely, the keeping of bantams for the sake of their eggs and flesh. These diminutive birds have been mainly regarded for their ornamental or exhibition qualities. It is undoubtedly true that in relation to the space occupied by them, and the food cost, in comparison with the number of eggs and the quantity of flesh produced, these are among the most profitable of domestic poultry. As described in the " Report on the Poultry Industry in Belgium " (3),

the keeping of these birds by suburban and urban residents is encouraged in that country, for the reason that, as the products are not marketable, there is no temptation to sell, and the children are thus supplied with a valuable article of food, which is a great gain. Multitudes of people living under the conditions named could keep bantams profitably. A further point is that they are less likely to be a nuisance to neighbours than are larger fowls.

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CHAPTER XVII

CLIMATE AND SOIL IN RELATION TO POULTRY HUSBANDRY.

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CLIMATE AND SOIL IN RELATION TO POULTRY HUSBANDRY.

NATURAL INFLUENCES AND ADVANTAGES—CLIMATE—MOISTURE IN ATMOSPHERE—VARIATIONS OF CLIMATE—EFFECT OF SUNSHINE—SOIL—EFFECT OF SOIL ON GROWTH—SOILS IN RELATION TO BREEDS—CHANGE OF CONDITION AND ENVIRONMENT—APPLICATION IN PRACTICE—SOIL CONTAMINATION BY MANURE—NORTH *versus* SOUTH.

Natural Influences and advantages.—Formerly there was a general, but nevertheless an erroneous, opinion that the reason why eggs and poultry were produced to a much larger extent in some countries than in others, was that the climate was warmer. Experience has shown that such is not the case, and that in this respect the temperate, even the colder regions, where methods are adopted suited to the conditions, have yielded the highest results in respect to average productivity. An explanation of this fact is given below. It is not too much to say that the maxima is attained where there is no excess of heat or cold, and that the former is more repressive than the latter.

The United Kingdom has long been recognised as the centre of the world for the breeding of high class stock, although its supremacy is challenged in not a few areas where the breeding of poultry is being conducted on progressive lines. In this respect we may fairly give credit to the skill of breeders, and, in older settled countries, to the somewhat cramped conditions under which stock are kept and bred. Under such conditions more rigid selection has to be made than is necessary in a larger and thinly populated country. That the skill referred to is the direct result of favourable conditions which, in turn, have developed the knowledge and power, is apparent. Whilst, therefore, giving full credit to stock-raisers for the manner in which

they have perfected the different races and breeds of domestic animals, it can fairly be claimed that their skill has been assisted by their environment. It may, in this connection be asked, Why is it that animals, also human beings inhabiting moist, temperate zones, are usually fuller bodied than is the case in warmer climes ? Part of this is due to the food upon which they live, yet not entirely. In this respect it is important to note that variations in man and animal follow upon a change from a moist to a very dry climate, and *vice versa*, offering a field for inquiry of which some of the main points may be considered.

Climate.—As already stated temperate zones have manifest advantages over those areas where extremes prevail. Large portions of Europe, North America, Australia, New Zealand, South America and South Africa have a temperate climate. These countries, however, vary to a considerable degree. Instead of high temperature in summer being an advantage, the reverse is true. Those who have travelled in these regions, as we have extensively done, realise that intense heat burns up the vegetation, and thus the supply of natural food is enormously reduced. Also that evaporation of body moisture takes place to a large degree, which explains why stock is leaner during hot weather and in hot climates than in cooler weather and colder countries. Excessive heat is as disadvantageous, possibly more so, as extreme cold, and is less easily overcome. A moist climate, by keeping the herbage in good condition nearly all the year round, exercises a beneficial influence which has not been estimated at its full value. In this respect the United Kingdom, the Pacific Slope of North America and New Zealand are favoured. In these natural food, both animal and vegetable, is plentiful almost the whole year round.

With the prevalence of high temperatures the evaporation of body moisture leads to an hardening of the muscles and tissues. It is also true that cold, by elimination of the heat force, has a tendency to reduce production. Where that is the case it can be overcome by feeding, at, however, an increased cost. In an equable climate all the conditions are present for the development of stock raising. A main reason why Ireland, New Zealand and Denmark produce such fine quality butter, and why the United Kingdom is famous for the richness of animal flesh upon its pastures, is due to the climate. The same is true of other lands where similar conditions prevail. In

this connection it is well to bear in mind that even within the confines of a small country like the United Kingdom places will be found which are more suited for breeding than feeding, for eggs than flesh, and *vice versa*. That fact should be kept in view. It is found in cattle and sheep. The conditions in any area both of climate and soil should be studied so that methods may be adopted which are conducive to a greater degree of success.

Moisture in Atmosphere.—The amount of moisture in the atmosphere has considerable influence upon the stock raised. The action may not be direct. It is, however, potent. Where a dry air prevails (dryness may be the result of either extreme cold or heat), the feeding quality of grass or other growth is affected, the influence of which is apparent in the eggs and flesh obtained from the fowls kept thereon. It is well-known that grass is richer in moist countries, most of all where salt from the sea permeates the air, unless the moisture is excessive; that it grows perhaps less rapidly but more constantly, and lasts much longer. Fowls originated in India, where they are small in size of body and not very productive in eggs. When larger birds are imported to improve the native fowls these lose size quickly by reason of the dry conditions. Moisture fills out the body, securing that increase in size and bulk which is characteristic of nearly all life in the temperate regions. As already seen, moisture increases the supply of natural food, and also its quality. In eggs 74 per cent of the total bulk consists of moisture. Thus, if a hen lays 180 eggs in twelve months, averaging 2 ounces, she produces 20 lbs. in total bulk, of which nearly 15 lbs. consists of moisture. The greater part of this will be obtained from the water she drinks, or that contained in the food, or directly from the atmosphere. In flesh also there is 72 per cent of moisture. A dry atmosphere, due to excessive heat or cold, tends to harden the muscles and reduce the bulk of flesh. At the opposite extreme an excess of moisture is undesirable. A wet place is usually cold, atmospherically and in the earth. Our object should be to avoid extremes.

Variations of Climate.—Great variations of climate are met with in many countries, more especially those which are very diversified in elevation. These have a profound influence upon the stock and produce. Mr. Primrose McConnell points out (1) that where the same

conditions prevail, in many cases, even though hundreds of miles apart, the stock is uniform in type. He says that "We find on the American continent, on the prairies, a region of land very similar to Eastern Europe, and this similarity tends to wipe out the differences between breeds. British breeds have a tendency there to lose their characteristics, and would in time, if allowed freedom, revert back to some common form when continuously bred under one set of geological surroundings." Our object in calling attention to this fact is that varying climate and conditions produce variations in breeds. In this direction altitude and exposure have great influence. The Gulf Stream explains why, in part, the British Isles and parts of Western Europe are temperate. Mr. McConnell says that (1) 'on the average, the month of January is warmer in the North of Scotland than in the Midlands (of England), and the cold winters of the Northern and Midland districts are the result of their elevation, rather than any difference of latitude.' It is necessary that attention should be given to this question, as it indicates the importance of keeping in view the climatic conditions in making choice of the branch of poultry husbandry to be followed. In countries which are uniform over a large area the same methods may be adopted. Where very varied these should conform to the conditions.

Effect of Sunshine.—Within recent years a considerable amount of attention has been given, more especially in the United States of America, to the effect or denial of sunshine upon poultry. This is surprising from the fact that, generally speaking, the number of hours in the course of twelve months during which there is bright sunshine are two or three times as many as are usual in parts of northern and western Europe, and that the intensity of the sun's rays is very much greater. It might have been expected that over the greater extent of the country named there was, if anything, too much sunshine during at least half of the year. As a fact in some of the southern States we have visited, special precautions were taken in the summer to afford a large amount of shade, for the reason that excess of direct sunlight checked growth in chickens, is often fatal, and is exhausting to all classes of stock. The same is true in other parts of the world which are within the torrid zones. In Britain there is not much trouble in that way. Although very occasionally hot summers are experienced, as a

rule we could do with much more sunshine, though, perhaps, it might not be so good for us. So far as stock raisers, inclusive of poultry-keepers, are concerned, there has not been until lately, and chiefly due to American experience, any attention given to this question. Medical experts are now, however, studying the subject, owing to the incidence of diseases in children especially where these are reared under crowded conditions such as prevail in the densely populated areas or the housing is antagonistic to their normal growth and development. That is suggestive. Breeders of poultry who give their birds free range, protecting them as far as possible against excess of sunshine in summer, or cold in winter, thus permitting them to obtain whatever in the way of natural food is available, do not need to concern themselves in this way. By adoption of highly intensified methods, in which practically all food that would otherwise be obtained naturally, save to a limited extent, is denied to the birds. As a result these are kept on more or less manure-contaminated ground, or entirely within sheds. The food supplied is frequently either deficient in essential constituent elements, or is ill balanced. Also in order to conserve warmth and to prevent the driving into the sheds of rain or snow, glass is frequently used to cover part of the open or wire-netted fronts. Research has revealed the fact that the birds are thus deprived of those influences which are derived from sunshine. Heavy loss frequently arises from what is known as leg-weakness, or rickets in chickens, and reduction of vitality in birds of all ages.

Investigations have clearly indicated that leg-weakness is due to deficiency in the composition of bones in growing chicks. It is suggestive in other directions. Observations made at the Manhattan Agricultural College, U.S.A. (2) are described as follows:

'Prior to the summer of 1923 chickens had not been successfully raised in confinement. When attempts were made to rear chickens indoors, leg-weakness was almost sure to develop in the course of from two to six weeks. No type of feeding with ordinary poultry food would prevent this disorder. The only way in which leg-weakness could be prevented was to get the chicks out on the ground. In 1923 it was found that contact with the soil had nothing to do with preventing leg-weakness, but that the benefit came from the direct sunshine.' As indicative of the importance of light upon the structure of the bones

the figures recorded are suggestive, namely, that in chickens raised under different conditions the percentages of ash varied considerably and fundamentally :

	% ash in leg.	% ash in bone of beak.
Direct sunshine	58.2	48.4
Light through window glass ...	48.4	27.2
Diffused light in laboratory ...	43.3	28.1
Dark room	47.2	25.6

It was also found that in the case of laying hens the hatchability of eggs was 75.45 per cent where there was direct sunshine, and only 52.9 per cent where light had passed through window glass. The explanation is that 'window glass transmits the longer ultra violet rays, ranging in wave length from 400 mu. to about 360 mu., almost as well as it does the visible portion of the spectrum, beginning about 360 mu. The transmission through window glass drops off very rapidly, becoming zero at about 320 mu. None of the ultra violet rays shorter than 320 mu. is transmitted through window glass. These rays shorter than 320 mu. seem to be the only ones which have the property of preventing rickets. For this reason glass-filtered light has very little, if any, antirachitic property. Non-glass-filtered sunshine depends upon this very narrow band of rays extending from about 320 mu., the longest waves which are effective in preventing rickets, to 290 mu., the shortest ray in the sunshine which reaches the surface of the earth.' (2)

That the sun is the centre of our universe cannot be questioned. It supplies light and heat to animal and plant, it is the power of motion, it purifies the atmosphere and the soil by destroying deleterious parasites and bacteria, and in that manner is preventive of disease. Its influence is stored in all living forms directly and through the food consumed. Any deficiency in that respect has a baleful influence. Under the more intensive methods of Poultry Husbandry, adopted as a means of increasing productivity more especially in eggs, what is here stated has been ignored until recently when the ever increasing loss among chickens and adults has led to study of the causes. How far the application of artificial light by quartz and other lamps can be made profitably has yet to be proved, as also whether the special forms of glass which, it is claimed, do not prevent passage of the beneficial rays

already referred to, may be effective, has yet to be fully determined. A further question is, whether what are known as vitamins found in fresh, natural food, may not be reduced where growth of vegetable products is forced. This is further referred to in Chapter VII. It is evident that sunshine is of the utmost importance, though excessive heat would appear to be weakening. The older theory of as much sun in winter and spring, and as much shade during the periods of high temperature, still holds the field. The fact that as great, if not greater success in respect to breeding of poultry and to average production, has been attained in countries where the duration and intensity of sunshine is much below others, is a proof that nature adapts her creatures to their environment.

Soil.—A much more difficult branch of the subject, and one which has not received adequate attention, is that of the nature of soil in relation to production. It is recognised that soil must have considerable influence upon animals and plants which are kept or grown thereon, and that many of the variations met with in these are due to the earth and the food grown upon it. Further, that the quality of eggs and flesh is largely determined in this manner. The suggestion has been made—but upon this point our knowledge is limited—that the coloration of our animals and birds is to some extent modified by the soil upon which they live. At this stage it would be impossible to express any definite opinion thereon. The claim that eggs produced upon iron-stone yield richer-coloured yolks than elsewhere, appears to be justified. There can be no question that whether the plumage is affected by the soil to the extent sometimes imagined or not, the colour of the legs and flesh is primarily due to natural causes. To the lighter soils we are indebted for the pale, or white-fleshed birds which are regarded as the finest for meat properties. Breeding and selection largely increases any tendency in these directions. As a rule in this manner are fixed modifications which have taken place naturally. Mr. McConnell, speaking of the horse, says (1): 'Within the last 1,000 or 1,500 years there has sprung up such a vast diversity of breeds within our (British) islands as cannot be matched elsewhere on the surface of the earth on an equal area. That the complex geological structure of these islands is at the bottom of the divergence is the belief of the present writer.' Such statement may be accepted as equally true

with respect to poultry, even though not a few breeds and varieties had their origin in other lands.

The tendency of light, dry soils is to bleach the legs and flesh, whilst, on the other hand, heavy soil deepens both. Our attention was first called to this subject many years ago by the experience of a well-known poultry exhibitor. He was a breeder of Plymouth Rock fowls, and was living on the heavy clay lands of eastern Essex. His birds were famous for the brilliancy of their leg colour. After some years he removed into Surrey, where the conditions were totally different and the land very light. The result was that the fowls' legs became much paler, except in one paddock where the soil was heavier and moist owing to the fact that on three sides it was surrounded by running streams. There the colour was maintained. This experience led to further observations, all of which have confirmed it. In selecting the breed, and consequently the branch of poultry-keeping, the nature of the soil is important. There is no effect without a cause. Variations met with in poultry are the results of varied conditions. Where breeding has been conducted for a sufficient period to induce changes, it is desirable that the class of fowl shall conform to the conditions under which it has been developed. This is not so much the various parts of a country as the immediate soil. For example, Dorkings thrive exceedingly well and attain great size in Scotland and Northern Ireland where the ground is favourable. Many of the best exhibition specimens of this breed have come from Northern Scotland and North Ireland. Poultry should be maintained upon soil which is most suited to them. Under other conditions there is always a greater tendency to variation.

Effect of Soil on Growth.—There is a great difference as to the rapidity with which chickens can be reared. This is partially due to the lie of the land. For example, land facing south, and having a slope of, say, 30°, receives the greatest amount of heat. A northern slope, even if the soil is identical in nature, at the same angle would be found 3° F. colder than the former. Under these conditions the earth temperature also varies. Mr. McConnell says (1): 'The difference in temperature due to mere wetness or dryness is considerable. Schubler found that the average of twelve soils gave a temperature of 100.5° F. in the wet state, as against 112.5° in a dry state, showing a difference

of 12° F.' Here is an explanation why chickens are much slower in growth on heavy land. As an instance may be mentioned the case of a farmer in one of the eastern counties of England who consulted us as to taking up the raising of chickens for market. He had visited districts of Kent only thirty miles away across the River Thames, where many of the finest chickens are produced, and he thought that this branch might be developed in his own county. We suggested that, as his farm was heavy clay land, it would be wiser to specialise in egg-production. However, he decided to make the attempt. After three years he gave up the branch named, for the reason that, whilst he was able to fatten the birds just as well as in Kent and Sussex, they never attained the same quality of flesh. Moreover, they required from three to five weeks longer to reach a fit size for the final process of fattening. This observation has been followed by many others, from which it is evident the nature of soil has a vast influence, and that the branch of poultry-keeping is determinable by the conditions. Damp land is not suitable for fowls. It is more so for ducks, provided the birds have a dry place for their night quarters. Clay land can be used for egg-production. Medium and lighter soil meet the requirements of raising chickens and other poultry embodying fine flesh qualities. A breed must be in sympathy with the local conditions. Mr. McConnell (1) deals with the temperature of the soil as follows:

'Sandy or gravelly soils absorb heat more rapidly and retain the heat longer than loam or clay do, and are therefore reckoned warmer and earlier soils. Dark-coloured soils absorb more heat than light-coloured ones, so, therefore, peaty and humous soils are warmer and earlier than whitish, chalky soils. The more moisture in a soil, the more of the sun's heat is used in warming up and evaporating this water, so that the temperature of the soil itself will be raised more slowly, and it will cool proportionately more quickly; therefore, damp soils are cool and later. The aspect of a soil, as facing south against facing north, will much affect the amount of the heat received from the sun, taking either any day of any season or the whole year. The inclination of any field will influence the amount of heat received from the sun; a plain will receive less than a sloping field inclined to the south, and a slope to the north least of all.'

Generally speaking it may be accepted that fowls with white flesh thrive best on light soils which are porous yet fertile; with grey flesh and legs on medium soils; those with yellow flesh and legs on heavier soils. The finest eggs are produced on heavier soils. Sand, although dry, is lacking in natural feed whether vegetable or animal, and absorbs heat or cold very rapidly. Poultry in process of time add greatly to the fertility even of the poorest soil. The herbage produced by the earth determines its value for stock purposes. If it is not rich enough to grow edible plant life, it is of a low standard of value for poultry.

Soils in Relation to Breeds.—This question is one which must be dealt with generally, for the reason that there are considerable differences in constitutional vigour of varieties of the same breed, even of the respective strains. The following summarises conclusions which are capable of almost universal adoption:

FOWLS.

Egg-Production.—Under this designation are included both the non-sitters and general purpose breeds, the former of which are naturally the more prolific, the latter better winter layers.

Position.	Breeds recommended.
Cold, exposed situations, or clay soils.	Ancona.
	Leghorn.
	Barnevelder.
	Plymouth Rock.
	Rhode Island Red.
	Wyandotte.
Medium soils.	Braekel.
	Bresse.
	Campine.
	Houdan.
	Minorca.
	Redcap.
	Scotch Grey.
	Sussex, Light.
	Faverolle.
	Orpington.

Gravelly or light soils.	Favourable for all races and those named above.

Flesh-Production.—Although the finer qualities of table fowls and poultry cannot be raised on heavier lands, good birds may be bred there, more especially those with yellow or creamy flesh.

Position.	Breeds recommended.
Clay soils.	Langshan. Black Orpington. Plymouth Rock. Rhode Island Red. Wyandotte.
Medium soils.	Bresse. Faverolle. Malines. Buff and White Orpington. Scotch Grey. Sussex, Light.
Gravelly or lighter soils.	Dorking. Game. Sussex, other than light. Other French breeds.

Crosses.—So far as these are concerned, it is needless to describe them. The colour of leg and skin as indicated above is a determining factor in selection for crossing.

WATER-FOWL AND TURKEYS.

Ducks.	Gravelly soils in valleys with streams most suitable; high lands undesirable in summer; peaty soils excellent; marshy, undrained land to be avoided.
Geese.	For hatching and rearing, down and hill land preferable; for feeding-off good grass and pasture land.
Turkeys.	Clay or damp land fatal; should be kept on medium soil, which should be well drained.

Change of Conditions and Environment.—Farmers and others recognise that, as a rule, manifest benefits arise in larger live stock by

changes of conditions. Hitherto the importance of such change has not received much attention from those engaged in Poultry Husbandry. That it would not be profitable to transfer growing birds to be raised elsewhere than the place of hatching, as is frequently done by breeders of the heavier type of horses, may be accepted. It is desirable from time to time to obtain the benefit of changed conditions, either by purchase of stock, or of eggs for hatching, or by having birds reared on a totally different soil. It is found that where the poultry-keeping has been intensive, it is, at least, desirable to vacate the ground for three or four years so that it may have a prolonged rest. Otherwise it will be desirable to introduce entirely fresh stock. Our object is to indicate the influence of change of soil and environment upon the birds.

Many variations in domestic poultry are the result of changed conditions. On the whole these are highly beneficial. Change of environment influences growth and productivity, as well as modifying characters. The late Professor Charles Darwin, quoting the remarks of an experienced breeder, refers to this influence, and says (3) : 'It is a well-known fact that a change of soil and climate effect perhaps as great a change in the constitution as would result from an infusion of fresh blood.' He, however, indicates that the change is not always beneficial. There are instances on record where changed conditions in the case of domesticated animals have apparently led to infertility. That, however, may be due to other influences such as loss of vitality in stock, often arising from a too restricted environment. In the temperate zones, with exceptions, the fowl generally is very fertile. We have met with instances where a race or family which at one place was characterised by great egg-production or by high flesh qualities, when removed to other conditions were distinctly inferior in these respects. The breeder must constantly keep in view that variations in respect to environment appear to be absolutely essential to maintain our birds in full vigour and productivity, and that he must endeavour as far as possible to recognise influences which will contribute to his greater success.

Darwin (3) suggested that change of conditions exerts considerable influence in maintaining the stamina of our races of animals and birds, and says : 'It is a law of Nature that all organic beings should occasion-

ally cross, but it appeared to me probable that the good derived from slight changes in the conditions of life from being an analogous phenomenon might serve the purpose. No two individuals, and still less varieties, are absolutely alike in constitution and structure, and when the germ of one is fertilised by the male element of another, we may believe that it is acted on in a somewhat similar manner when exposed to slightly changed conditions.'

Application in Practice.—Systems which are successful in connection with plant life are, in many instances, equally applicable to animals. No practical farmer would think of growing the same crop year after year upon one field, which fact has led to the adoption of rotation in cultivation. Also in connection with gardening it is necessary, where the ground is occupied for a succession of years, with a similar crop, to use seed which has been grown elsewhere, and in that case practically what we are advocating is carried out. If the seed obtained from any crop were planted again upon the same land, very speedily degeneracy would result. There would be both a lessened quantity and quality of produce. What is true in that case is equally so with poultry. Were what is stated recognised, much of the advocacy of fresh blood would be seen as due to recognition by practical experience of the fact that stock kept upon the same land gradually loses its vigour and productiveness. To quote the remarks of an experienced farmer, published many years ago (4): 'Nothing can be more clearly established in agriculture than that growth of any one variety in the same district makes it liable to deterioration either in quality or quantity.' Many instances have been met with where fowls have been kept on the same land for several years, and the measure of success realised at first was not maintained. With the introduction of fresh stock it has been found that these grow better and are more productive. To this cause may be attributed much of the favour with which new breeds of poultry are regarded. Often credit given to the breed or variety is not attributable to them, the fact being that the greater success achieved is due to the new conditions. Interchange is highly beneficial. Often the increase of vigour, egg and flesh production, found when fowls are removed from one country to another, is attributable to the stimulus given under the entirely new conditions.

A common practice among ordinary poultry-keepers, when they

are introducing fresh stock, is to purchase them as near home as possible. Where the place from which the birds are secured is sufficiently varied, the object is achieved. In some countries, notably the British Isles, there is a great diversity of conditions. Within a radius of two or three miles there may be three or four different classes of soil, and also distinct altitudes. There the influence is very marked. Otherwise, it is desirable to go much farther afield, thus securing birds which have been raised, perhaps, for two or three generations, upon different soil and conditions. In so far as the land is extensive there are manifest advantages. Supposing that the land is undulating, or in the hilly districts comprise both high and low land, it is advantageous to rear the birds entirely apart from where the breeding stock is maintained.

Soil Contamination by Manure.—Reference has been made in Chapter I to the important part which poultry play, if permitted to do so, in maintaining the fertility of soil by the manure produced by them. Where restricted to one area, especially if intensive or semi-intensive methods are adopted, the risks of soil contamination are considerable. It is not too much to state that more than half of the disease which is met with, and the losses which follow, arise from more manure being added to the soil than it is able to utilise by plant growth. What has to be guarded against is the steady accumulation of manurial elements, even though not apparent for some years, varying in accordance with the number of stock per acre, the degree to which the soil is cropped, whether it is pasture or ploughed, how far it is effectively drained, and its nature. Heavy land is more retentive of manurial elements than lighter soils. As is the case in almost every phase of life, what is of the utmost value to supply the stock or plants with the materials for growth, when in moderation, becomes the root cause of disease when in excess. This question is of the utmost importance to all who are engaged in the raising of any kind of stock.

North versus South.—The late Louis Van der Snickt, of Brussels, suggested that change of conditions is responsible for variations in egg and flesh production, usually attributed to other influence, that is, apart from selective breeding. He instanced that wild birds fly to colder regions, whether these be north or south, for the breeding season. In the covering of long distances, as many do, the expenditure of physical energy reduces the reserves of fat accumulated under milder

conditions. Not alone is that the case, but the colder and more bracing air stimulates the breeding activities. From that fact he deduced that in connection with poultry, a similar racial influence is exerted upon birds which are transferred from the country or district where reared to another, so long as the new habitat is not too extreme from the place of origin. The late Charles Darwin pointed out that (3): 'The fowl, a native of the hot jungles of India, becomes more fertile than its parent stock in every quarter of the world until we advance as far north as Greenland and North Siberia, where this bird will not breed.' Our observations since this suggestion was made have supported this theory. All the Mediterranean races of fowls are better layers in the colder than the warmer regions. Birds of a hardy type when transferred from milder areas to more bracing conditions are there more productive in eggs, apart from methods of feeding and management, probably owing to the greater activity of body thus induced by the more rigorous environment. On the other hand, birds transferred from colder to warmer countries, and from an upland district to a lower-lying and, therefore, milder area, tend to lethargy of habit and to increase of flesh. Such is in accordance with experience in the case of cattle and sheep. It does not, however, apply where there are great extremes of heat and cold.

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CHAPTER XVIII

POULTRY HUSBANDRY ON FARMS.

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AGRICULTURE AND POULTRY HUSBANDRY—EGGS OR FLESH—"PIN MONEY"—HOMESTEAD METHODS—DISTRIBUTION OVER THE LAND—PORTABLE HOUSES—ENCLOSED YARDS—WINTER EGG-PRODUCTION—CLASS OF STOCK—RISKS OF LOSS—HATCHING AND REARING—POULTRY ON FRUIT FARMS—LABOUR.

Agriculture and Poultry Husbandry.—What first led the author to devote himself to efforts for the extension of this branch of live stock, was the fact that in Great Britain were vast resources as yet explored to a very small extent, and which were capable of adding enormously to home food supplies and to the incomes of farmers. At the period named, half a century ago, the poultry kept upon farms were less than half a fowl per acre of cultivated land. Considerable progress has been made, mainly, however, in respect to specialised production by adoption of commercial methods, or by smaller occupiers living in urban or suburban areas. These aspects are dealt with in later chapters. Farmers generally have been slow to move. Within later years many have proved, for which documentary evidence is now available, that where right conditions are provided, poultry are the most profitable of all live stock. In spite of what is here stated the fact remains that at least eighty per cent of eggs and poultry produced in all the more important nations are derived from general farms. In the United States it has been estimated that 95 per cent of these supplies are from farms, and the same proportion is given in Canada, though the proportion varies considerably in the different States and Provinces. In Denmark and the Netherlands the ratio is 99 per cent. The same is true in France and all other European countries, and in Ireland. The fact is evident that farm poultry keeping is, and will continue to be,

the most profitable and promising branch of Poultry Husbandry. Hence the importance of developing it as an integral part of agriculture, not alone to meet the already enormous demand for eggs and poultry, but in anticipation of future requirements. To create greater consumption there must be increased supplies. Within recent years there has been considerable extension of Commercial Poultry farms, without which the needs of the country could not have been supplied. By example, and the providing of stock with greater economic value on Breeding Poultry Farms, a great service has been rendered, and an example set which is altering the outlook of farmers with respect to poultry, thus leading to abandonment of long cherished ideas and prejudices.

Eggs or Flesh.—There must, however, be a definite aim in all enterprises. Too long have haphazard methods been dominant. Whilst a hen is ever a hen, there are wide differences in productivity and profit. It is essential, therefore, that consideration should be given to—(1) the capacity of the farm, (2) the nature of the climate and soil, (3) the product which will yield the highest returns, and market demands, and (4) the labour available. These are dealt with more fully below.

Generally speaking, in almost all countries the majority of farmers find that egg-production is the most profitable part of their poultry operations, by reason of the fact that there is always a good demand for these. Prices have advanced during the present century, and especially since the Great War, except where the quantity is small or the local organisation for marketing is at fault. A further fact is that egg-production entails less labour than the raising of table poultry. There are, however, many exceptions to be met with. By reason of special conditions favourable to the raising of high class birds with fine quality flesh, and where a large demand has been created whether chickens, ducklings or turkeys, more attention is given to these than to eggs. Formerly that was the case everywhere. It was the flesh which gave value to the poultry. Such examples are to be met with in Britain, Belgium, France, and North America. This branch, however, has not increased to the same extent as egg-production. It is useless raising high-class poultry unless there is a profitable market for it. In the case of fowls a prime essential is the proximity of fattening centres, where the birds can be finished off. Lean fowls, if killed forthwith,

are of much less value than when they are fed before these are slaughtered. To secure a trade there must be a fairly regular supply, which can best be accomplished where a considerable number of people are operating on similar lines.

Let it be understood that the farmer who makes egg-production his main object will have chickens and old hens for sale at certain seasons, and must make the best of them; and that the breeder of table poultry will also have to dispose of eggs not required for hatching. Further, there are districts which are in close proximity to residential areas and holiday resorts, where there is a large demand for eggs, and in some cases for poultry. Usually in the industrial centres eggs are sold much more largely than poultry, except at special seasons.

"Pin Money."—Where the number of fowls maintained upon any farm is comparatively small, the simplest, easiest and cheapest method is keeping them around the homestead, where they will find the greater part of their food. Such is the picturesque aspect of poultry husbandry, as revealed in the paintings of John Herring, of the late Harrison Weir, and others. Usually the flock is a mixed one: fowls in the greater proportion, a few ducks, perhaps some geese and turkeys. If properly managed there is no branch which returns an equal return for the outlay, even though the corn which the farmer's wife obtains for nothing be charged as a debit. That is termed "pin-money poultry-keeping." For this she is able to purchase many things without asking her husband for the cash. It does not, however, exhaust the possibilities of production on such farms, even though it strictly limits the output. By concentration upon a comparatively restricted area the soil may become in process of time what is known as "fowl sick," that is, impregnated with manurial elements. Therefore, where such system is adopted, the number of adults must be restricted in accordance with the conditions. What that number should be is difficult to state. The determining factor is the extent of the farm yard and adjacent paddocks. Usually twenty to forty is quite sufficient. Nearly all the great epidemics observed have been due to increase of numbers without modification of method. With such increase the birds must be spread over the land.

Homestead Methods.—So far as housing is concerned the principles laid down in Chapter XXII should be carefully studied. There are,

however, a few points which require emphasis, namely, that there should be no overcrowding in the roosting quarters. The capacity of air-space in a poultry house should be at least 10 cubic feet per inmate, that is, for each fowl, and the same applies to ducks. Geese and turkeys require at least 40 cubic feet of air-space for each bird. With respect to permanent houses for fowls, a general mistake is made in building so that light and ventilation are inadequate. These would be much more suitable if made open fronted, which would at once solve the problem here indicated. The old notion as to conservation of warmth being conducive to prolificacy, in which the circulation of air is restricted, has been exploded. As homestead fowls are able to obtain plenty of exercise, and can usually find shelter against wind and rain, scratching sheds are not requisite.

The natural methods of hatching and rearing described in Chapters XXVI and XXVII, are usually found most suited to farm operations, provided that the chickens are hatched early enough to come into lay the following autumn. That will depend to some extent upon the breed or breeds. Where non-sitters alone are kept artificial systems are indispensable. In any case, however, an incubator is valuable, in order that the time of hatching may be under control. In this connection it is supremely important that the rearing ground shall be changed each year. There are few farms where it is impossible to secure variation in this respect from one season to another.

A branch of poultry work for which the homestead method is specially suited is where chickens are raised for sale to fatteners. On an ordinary small farm, by keeping a flock of, say, twenty-five breeders, two to three hundred chickens can be raised annually. Under such circumstances an incubator and brooders are found necessary for securing early chicks. Fresh rearing ground should be provided every year.

Distribution over the Land.—When it is desired to extend operations a prime necessity is to distribute the birds over the land, thus forming an integral part of the operations, and in rotation with the crops, whatever these may be. On pastures there is no restriction as to crops. Alone in that manner can the capacity of production be attained. Taking a 100-acre farm with fair-sized buildings, if all the birds are concentrated around the homestead it would be inadvisable to keep more than thirty to forty adults, or fifty at most. The highest

of these figures would only represent half a fowl per acre. With a larger farm of three hundred acres the percentage would be much lower. General experience is that the larger the farm the smaller is the average of fowls per acre, mainly due to labour questions. It is the method, not the possibilities, that is responsible.

Unless, therefore, what are known as extensive methods are adopted, it is impossible to expect realisation of increased production which is our aim. That fact was recognised in the later years of the Nineteenth Century as a result of painful experience, leading in some sections of Britain and Ireland, as had been the case previously in other European countries, to an advance which, small as compared with what yet may be, has been considerable. In Canada, during the winters, restriction is imperative. At other seasons distribution is more general. In the United States for a long time concentration, even where land was abundant, was the rule. That is now changing and a greater amount of range is given. So far as farm poultry husbandry is concerned the need is to distribute over the land for the reasons already stated. In this way the costs of feeding are reduced to a very considerable extent, as is that of equipment.

Portable Houses.—There are two ways in which the distributive or extensive system can be applied—namely, by use of portable huts, or by what is known as the colony method. The latter is specially suited to small farms and allotments, although it may be adopted on larger holdings. Information is given respecting it in the next chapter, where it is seen that the buildings are capable of removal from time to time as required.

Many forms of portable houses are used. So long as these conform to the principles laid down in Chapter XXII, the shape and build is of lesser importance. As the main object is to distribute the fowls in relation to the method of cropping, it is, as a question of labour, desirable that these shall be easily removable from one field to another, or even on the same field. To do that frequently and easily the size must be limited, otherwise the house would be too heavy and cumbersome. Usually we find that the most useful sizes are 7 feet long by 5 feet deep, or 5 feet long by 5 feet deep, the former of which will accommodate twenty fowls and the latter fifteen. For breeding flocks consisting of ten inmates a useful size is 5 feet long by 4 feet deep. It is

false economy to overcrowd the birds, and more space than stated is no disadvantage. In erecting a structure of this nature the most important consideration is to have a stout frame, otherwise it will not stand the strain of frequent removal. This is especially true as regards the bottom joists.

Enclosed Yards.—As a general principle in connection with farm poultry wire netting is not required, as the essential factor is distribution over the land and freedom for the birds. Frequently, however, it is convenient to have a few houses and runs in a suitable location near the homestead reserved for special purposes and at various seasons. Such may be used for breeding pens when selected birds are mated. In practice it is found that two or three such flocks can be kept at liberty in a single field, if of a reasonable size, without danger of mixing, provided there is an active male with each lot and they have separate houses. The more liberty that can be given to breeding stock the better. When very early eggs for hatching are desired, the plan of having one or more flocks near home is to be recommended, necessitating enclosure. These can thus be given a greater amount of shelter in unfavourable weather. Enclosed yards may be useful for isolating male birds, for chickens that are not old enough to be put out on range, for old hens, for fresh stock to be kept under observation before added to the flocks, and for many other purposes. In each run a portable house should be placed, which may at other times be used in the ordinary manner on the fields.

Winter Egg-Production.—Although the supplies of eggs in winter are obtained to a much larger degree proportionally to the stocks of poultry from special and commercial poultry plants than ordinary farms, it is to the interest of farmers to take all necessary steps in this direction. That would considerably add to their returns and profits. Attention is therefore directed to Chapter XXI. It is a fact which has been abundantly proved that exposure to inclement weather during the colder months of the year reduces the output of eggs, and increases the costs of feeding, due to the more rapid elimination of bodily heat and assimilisation of food. This can be counteracted to a very large extent by the provision of Scratching Sheds described in Chapter XXII. These are built large enough to permit of abundant space if it is thought desirable to keep the birds entirely under cover during unfavourable

weather, or to permit them to stay within the house if they prefer that to the open at any time. As indicated in the Chapter referred to such sheds must be almost as light as the open air, be effectively ventilated, and have abundance of litter so that the inmates may obtain exercise by scratching for grain scattered in it. A house of this nature will be a wise investment for any farmer who is paying proper attention to his poultry, whether it be one of the permanent buildings adapted to the purpose or specially erected. A profitable unit is 150 laying hens as a maximum. To allow of four square feet of floor space for each bird a shed of this type should be 40 feet long by 16 feet from back to front; for 120 hens it should be 30 feet by 16 feet; and for 80 birds 20 feet by 16 feet.

Class of Stock.—What is stated in Vol. I. as to the various races of poultry should be carefully studied, and inquiries made as to experience in the district of those already engaged in the business. Success or failure will in part be determined by properly selected and mated breeds. The same is true in respect to observations as to the numbers which should be maintained. Upon these points, therefore, not much need be added. We do not expect farm poultry to have the same high standard of racial excellence as those which are bred by specialists. They may appear to be rougher and of a commoner type, though that may only be on the surface. Profit will be determined by the returns in comparison with the costs. Primary selection should, in the first place, be in accordance with known qualities, as far as possible, or with such type as appears contributory in that direction. What has been said as to vigour of constitution is an important consideration, especially in view of the fact that the general conditions on a farm may be more rigid than on smaller plants. Farmers are well advised to pay due attention to racial characteristics, but not to carry these to an extreme. What is required is to avoid intermixing, to pay special attention to the quality, physically and racially, and the family record of male birds purchased. That will be the best method of maintaining the virility and productivity of the stock. It will only be necessary to buy a few males every season, if the breeding operations are on systematic lines.

Risks of Loss.—Reference has already been made in Chapter XVI to the serious repression in some districts upon the keeping of poultry

owing to fox preservation. Although it is correct to state that these predatory vermin when hungry will burrow under wire netting where that is used to enclose the poultry, the risks are increased under extensive methods. Also, labour is increased by having to close the houses each evening and open in the morning. In the countries where the sport of hunting does not appertain those who engage in poultry husbandry have a much freer hand. The claim is frequently made that farmers must protect their fowls by wire netting and by shutting up the birds early in the afternoon. They, however, ought not to bear the costs of the former or be called upon to engage in the labour involved by the last named. The onus for protection against loss is on those who are responsible for preservation of these destructive animals. In some instances those concerned have been compelled by the action of hunting men to defend themselves by ruthlessly killing every fox which came near, in which they are fully justified.

Stealing of fowls has always been prevalent in almost all countries. These birds can easily be carried away, and are difficult to recognise. That the risks of loss are greater under extensive methods cannot be questioned. As a rule it is found necessary in the more densely populated districts to protect the poultry from thieves as far as possible by dogs, traps, etc., and to prosecute with rigour those who are caught in the act. Losses by stealing are, unfortunately, common in every pursuit. In that respect poultry husbandry is no better or worse placed than are others.

In the less settled countries there still remain predatory animals and birds which have to be combatted. In others rooks and a few of the smaller wild birds often give great trouble by carrying off young chickens. These enemies must be shot down. On smaller occupations cats and rats are very destructive, and the loss is often considerable. Shooting the former and killing the latter by other means must be left to such ingenuity as can be devised.

Hatching and Rearing.—Detailed descriptions of methods and appliances are given in Chapters XXVI and XXVII. There are, however, considerations which are of special application to farm poultry husbandry. First of these is the importance of much earlier hatching upon farms than is customary. Observations indicate that the general size of chickens upon many farms in the month of June is what ought

SEX-LINKED RHODE ISLAND RED × LIGHT SUSSEX PULLETS IN ORCHARD
(Messrs. John Chivers & Sons, Ltd., Histon, Cambs., England. Freedom of range and Natural Feed in abundance)

to be the case in April or early May, that is, in the northern hemisphere. This is doubtless often due to lack of broody hens, not to that of fertile eggs. The question is discussed in later chapters from special aspects —namely, the influence of earlier hatching upon supply of winter eggs, and the marketing of chickens and ducklings when prices are most favourable. It is desirable to advance the time of hatching by a month to six weeks, though in that respect the conditions of each district have to be taken into consideration. Where the situation is colder and more exposed, especially in higher altitudes, hens are often later in laying and becoming broody. Hence the value of an incubator. The line of profit where chicken and duckling raising is an object is to hatch as early as fertile eggs are available. In that case special methods are essential. Generally, however, the preferable plan is to rear the birds on range, to harden them by compelling exercise, and to allow them to forage over as wide an area as possible, that is, prior to the finishing stages.

Poultry on Fruit Farms.—Observations on the orchards of Normandy and the vineyard districts of France have shown that for generations the combination of poultry raising and fruit growing has been highly profitable, and that the birds contribute greatly to success by fertilisation of the soil, and by keeping down parasites which prey upon the fruit. The manager of one of the best vineyards in the Medoc stated to us that he would not grow the vine unless he were permitted to keep as many fowls as he thought fit. The latter are subsidiary to the fruit, but can themselves be made profitable. Further, the quality of poultry flesh produced under such conditions is usually very fine, owing to the nature of the soil and the large amount of natural food obtained. Reference may be made to the enterprise of Messrs. J. Chivers and Sons, of Histon, Cambs., England, upon whose fruit farms, extending to more than a thousand acres, poultry are kept in large numbers.* The principles adopted, which are simple in the extreme, are capable of duplication elsewhere on a scale relative to the size of orchards. The houses are of an ordinary type, generally modest in size so as to permit removal as may be thought desirable. These are distributed among the fruit orchards. The method adopted, with a few exceptions for special purposes such as breeding and duck raising, is distributive. Concentration is alone found at what may be regarded

* Plates LXX and LXXI.

as the centre of the enterprise—that is, where are the buildings for hatching and fattening, stores, etc. Surrounded by orchards, the breeding and laying adults, and the chickens, whether under hens or in brooders, are placed between the rows of trees and bushes, where the conditions are ideal. Spread about in this manner, there is no danger of debilitation or of disease in young or old birds as a result of contaminated soil. The amount of natural food obtainable is so large that at some seasons of the year very little has to be supplied. There is great saving in cost of equipment as wire netting is not used. Excellent results have been obtained in respect to both eggs and table poultry. Whilst the average egg-production under such conditions may not equal those obtained as a result of more intensive methods, profit is actually greater, due to lower costs in plant, feeding, labour, and general upkeep.

Labour.—So far as larger farms are concerned, the main difficulty in respect to skilled labour has been absence of knowledge and experience in the principles of poultry husbandry on the part of farm workers, who, in too many instances, like their employers, have regarded hens of small moment, and that anyone can manage poultry. There are skilled poultrymen available, although the number is all too few. Not many farmers would find it worth their while to engage labour for this purpose alone. What they require is that the agricultural labourer shall attend to the poultry as part of his work. The lack in this respect has undoubtedly retarded development. The problem may be solved in process of time, but has not yet been reached. When, therefore, the poultry operations are beyond the scope of his wife, or daughter, and has become extensive rather than concentrated, the labour question has often proved to be the main difficulty. What needs to be done is to train the younger generation, and with a largely increased number of small holdings upon which poultry occupy an important place, and of allotments where the rural worker can gain experience with his own hens, the younger people will have their interest in this branch awakened, and be available for employment on farms. Instruction in poultry husbandry has generally been beyond the reach of this class, as have the opportunities of gaining knowledge by actual practice.

CHAPTER XIX

POULTRY ON SMALL HOLDINGS AND ALLOTMENTS.

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SMALL HOLDINGS—STOCK AND EQUIPMENT—THE COLONY SYSTEM—A BELGIAN OBJECT LESSON—RHODE ISLAND, U.S.A.—SOUTH SHORE, MASS. U.S.A.—CHICKEN-PRODUCTION—ALLOTMENTS—BURNLEY AND ITS ALLOTMENTS.

The term "small holding" is generally applied to all occupations from 5 to 50 acres, whilst "allotment" is understood to mean those of less than 5 acres. Such is the case in Great Britain and Ireland. Elsewhere the term "farm" is usually applied to all holdings which are cultivated. In Britain, the size of occupations varies to a remarkable extent considering the small total area of the country as compared with others. Excepting the big ranches in the more recent settled countries, and which may be regarded as to some extent temporary until the land has been occupied by a larger population, farms are moderate in extent, as a consequence of which methods have to be intensified to some degree. There can be no question that this tends to the wider prosperity of any country, so long as the holdings permit of yielding an adequate living. Prior to what is termed the industrial age, population was widely distributed. In those countries where manufactures and commerce have become dominant factors, the balance between town and country has passed from the latter to the former, and, in not a few cases, the rural population has dwindled, with loss of that virility which makes for a strong nation. Poultry husbandry is a branch of live stock which is specially suited to those whose occupations are limited.

Small Holdings.—It is evident that if a satisfactory living is to be derived from smaller occupations, the average production must be enhanced considerably above that which prevails on larger farms, or the standard of life be a low one. Size of occupation, the nature of

the land, the labour required, and the capital expended are all of importance. The great difference, however, between results obtained on farms of the same acreage is not only by reason of the soil and position, but how it is cultivated and stocked. Small holders must produce more per acre than larger farmers if they are to make an adequate return. Therefore the poultry must be kept on more intensive lines. The number of poultry kept decreases *pro rata* to the increased size of holding, due to the difficulties arising from supply of labour It is on the smaller occupations that the bulk of eggs and poultry are produced. Future development of poultry husbandry depends in great measure upon extension of this class of the rural population. That such increase would do much to add to the fertility and productiveness of the soil is an important consideration. Poultry are, therefore, a much greater economic factor than has been generally recognised.

What has been stated previously as to stock and equipment applies especially to small holdings, as does the relative number of poultry kept to the acre. It has been our aim to see an average of three fowls per acre of cultivated land throughout the entire country. This means that on large farms the average would not be more than one fowl per acre, for reasons already stated. On farms of five to twenty acres there is no reason why ten fowls per acre should not be kept without any risks of contaminated soil, if the ground is systematically cropped, and without in any way interfering with the cultivation or reducing the number of other animals. From twenty to fifty acres probably eight fowls per acre would be a suitable average. In addition a considerable number of chickens could be raised. Under these circumstances there is no apparent reason why an average profit may not be attained of 5s. to 7s. 6d. per hen, plus the sale of chickens, etc. As supplemental to general farming, the poultry, if properly managed, can be made to yield a net profit of from £1 (5 dollars) to £2 (10 dollars) per acre. Where distribution cannot be carried out, and the birds must be kept around the homestead, the stock should be correspondingly decreased in number.

Stock and Equipment.—In commencing operations it would be desirable to buy eight to ten hens and a male as the basis of the stock, in addition to which a dozen or two day-old chicks of the same breed can be obtained, and thus provide an interchange of blood. In doing

this, the most profitable method is to purchase as good birds as can be afforded, by which is meant that these should be from a tested, prolific and vigorous strain. From such foundation the small holder will be able to build up his flocks of breeders and layers. In commencing one poultry house and a few coops or brooders will be necessary. As a temporary expedient he may make a rough-and-ready erection for the breeding pen, so long as it is well ventilated and the birds have abundance of space, or utilize an existing building. He may buy his first house, if able to do so, constructing others as these are required. Cheapness is not, however, the desiderata, and is often false economy. A great saving can be effected by building houses and coops in spare time.

Every house should be portable, which does not necessarily mean that it should be on wheels, but that in size and construction it can easily be conveyed to another location. Large, fixed buildings are a mistake under the conditions referred to, not only that to move them involves heavy labour and expense, but the difficulty of doing so frequently results in tainted ground by keeping too long on the same soil. Scratching sheds are, however, an exception in that the inmates spend so much time under cover. They do not fit in with rotation of crops, which should be always kept in mind. The ordinary poultry houses on wheels or runners are to be recommended on open fields, as these can be removed from place to place in a few minutes, and avoid damage to grass, also promoting a wide distribution of the manure, by which the land and crops are greatly benefitted. In this manner the convenience of the owner and health of the inmates are conserved, and the work is not hindered by rigidity. The system does not overtax either the resources or the labour of an energetic small holder, and if properly carried out has all the elements of permanency.

The Colony System.—Alternative to the distributive method is that known under the above name. Where adopted upon small holdings and allotments which are arable and cropped by ploughing or digging, it will yield the greatest return. There is, however, an increased cost for equipment as compared with the distributive method. It is necessary to isolate the birds by wire netting, especially if the adjacent land is under vegetables or small fruit. As compensation there is a considerable saving of labour. The birds are concentrated,

and can be rapidly attended to. Further, by the Colony method a larger stock can be kept in proportion to the total acreage. The principle underlying this system is that the birds are kept thickly on one field or part of the farm for twelve months, when they are bodily removed to another location. That vacated is not occupied again by the poultry until three years have elapsed, during which time it is cropped fully each season, which has the effect of utilising and exhausting the manure and of adding to the productivity of the farm. Usually it is found that there is no necessity to pen each flock of fowls. A fence of wire netting round the whole area occupied by the fowls is sufficient. The poultry form part of a four-course rotation. If such system were generally adopted, it would prevent much loss in virility and by disease, would add enormously to production by stock and crops, and open out a new field of endeavour.

A Belgian Object Lesson.—As an example of the dangers arising from destroying the balance between animal and plant life may be quoted Belgian experience prior to the Great War, which resulted in one of the most disastrous epidemics we have ever known. Instead of distribution, which had formerly been general, concentration became universal, and numbers were increased to an enormous extent without modification of method. Breeding from immature and forced stock so reduced the constitutional vigour that degeneracy supervened. The neglect of hygienic precautions and over-stocking of the land induced disease which spread like wildfire throughout Flanders and caused the deaths of hundreds of thousands of fowls. The story of methods adopted is fully told in the Author's " Report on the Poultry Industry in Belgium." (1) One instance needs only to be referred to: The Viscomte de Beughem owned an estate in the Lippeloo district of East Flanders, and for some years reared a large number of the famous poulets de Bruxelles. Every autumn about 600 Malines pullets were distributed with male birds among the farms on his estate, from thirty to fifty on each place. These remained the property of the Viscomte, and were usually replaced each year. The farmers fed and cared for the birds, selling the eggs to him, the prices varying from 1d. to 2d. (2 to 4 cents) each, in accordance with the season of the year. These eggs were incubated at the Château de Melis, the chickens hatched were reared during the earlier stages within enclosed runs, and afterwards

out in the woods, to be finally sold to the fatteners. Where the birds raised under these conditions were killed at an early age, no harm could possibly result. The system broke down from the fact that all the chickens were forced for rapid attainment of great size, and that breeding stock was selected from these birds. No attempt was made to conserve virility by use of fully matured stock, and by rearing those intended for reproductive purposes in a manner calculated to maintain and develop the constitutional vigour. It was an artificial system that rapidly sapped the stamina of the birds. When attacked by disease they were unable to resist these attacks. And the chickens hatched were degenerate. Had the system been conducted on the right lines, it was more than promising. The outbreak of the Great War brought it to an end, although the mortality in the preceding years had been enormous. In other parts of Flanders where equally intensive methods had been adopted, the effect was disastrous in the extreme. As a fact the Colony System had not been applied, in that there was no regular and systematic change of location for the fowls, or of a rotation with cropping.

Rhode Island, U.S.A.—One of the most striking, as it was one of the first, examples of application of the Colony System on general farms, was in the State named, to which we have paid several visits. Although some changes have taken place recently, the basis as described below remains the same. Nearly every farm in the Little Compton district carries a larger or smaller number. The conditions are very favourable indeed, and the climate milder in winter than is general in New England, due to the fact that the tongue of land, or peninsula, has the sea on three sides. It is within reach of Boston, which is one of the best markets. Instead of long range poultry houses, which are usually found in America, the huts are separate, grouped on one part of the land, and the whole removed to another part each twelve months. These houses are usually 8 by 12 feet, and 6 feet high, with gabled roofs. They have large windows in front, which can be opened, and the usual trap and door. Inside the fittings are simple. As there is no floor, the earth is thickly covered with sea-sand. In the majority of cases cattle are kept on the fields at the same time as the fowls. Where that is the case, it is customary to fix a rail fence around the house to keep the larger stock away from the water vessels and food troughs.

Each house is designed to accommodate thirty-five to forty fowls, and the customary plan is to allocate one such house to an acre of land. Thus, on a farm with, say, 1,000 layers, there would be about thirty houses, and a corresponding number of acres would be occupied by them. There was no overcrowding, and the balance between animal and plant was well maintained. The crux of the system was the annual removal to a fresh location. In addition to the area named, a further portion of land was occupied by chickens during the rearing season, when usually about 400 chickens could be reared to the acre in use. Such does not refer to the number present, but the yearly average. By reasonable stocking, thus preventing contaminated soil, and combining cultivation with poultry husbandry, the system here briefly referred to has proved successful for a long series of years, as indicated by the prosperity of this section.

South Shore, Mass., U.S.A.—As a further example of successful adoption of the Colony System may be mentioned the production of winter fowls to the south of Boston Bay in the United States of America, where, within a few miles thousands of these birds were reared and marketed annually. For local reasons, mainly the death of several of those who were mainly responsible, the industry has declined considerably. It presents, however, opportunities which deserve the present description. Some phases respecting it are dealt with in Chapter XXIX. Our present purpose is to point out that it is specially suited to small holdings, provided that, in order to secure a regular and sufficient supply, a number of occupiers in the same district operate on similar lines, and market in unison. Isolated attempts are of little use. In the district named farms varied from 40 acres upwards. The plan adopted was to keep breeding stock for producing eggs to be hatched. These were generally scattered about the holding, as long-range houses, necessitating enclosed yards, were less favourable. From these the chickens were bred. After the latter had passed through their earlier stages they were placed out on the land in colony houses, each with fifty inmates, and given free range. On one farm we visited, 6,000 chickens had that year been reared and marketed. The houses used were 7 by 6 feet, with open or netted fronts, well built, and removable as required. About 10 acres were in use for this purpose. As the rearing season extended over seven months

of the year, as soon as that was over the land was ploughed and planted with rye grass to sweeten the soil by utilisation of the manure. Even with that precaution, in some instances, as might be anticipated from what has been stated previously, it appeared that this was insufficient. Later the results were not so satisfactory, as indicated by reduced fertility in eggs and greater mortality in chickens.

This is an experience by no means exceptional, so long as the due relationship between animal and plant life is not maintained. Whatever success is achieved in the first few years is not the determining factor, but whether there is an accumulation of unexhausted manurial influence. That is where ultimately failure has so frequently been brought about. South Shore roasters, as they are called, are in many cases capons, and have not only an abundance but a fine quality of soft flesh. The system is capable of great extension under community conditions, where the numbers are not in excess of the capacity of the soil.

Chicken-Production.—References have already been made to the influence exerted upon prices obtained for lean chickens where fatting establishments are within reach. Under these conditions, provided the land is suitable and the necessary attention can be given, there is no more profitable work for the small, and the allotment holder, than the keeping of a suitable class of breeding stock, and rearing the chickens to about three months old, when they are sold to the fatteners. That is the system adopted so successfully in the south-eastern counties of England, and several districts of France, which are famous for high class table fowls. The parent stock need not be numerous, and, as the youngsters are speedily got rid of, and the work is seasonal and not continuous, there are few risks of keeping too many. What must be resisted is the temptation to unduly increase numbers and rear on intensive lines, the dangers of which have been indicated above. The Sussex and French methods are to rear under more or less natural conditions, even where a considerable number of birds may be raised every season.

The prime necessity is that there shall be a profitable outlet for the birds, either in supplying fatteners or direct to the market. It is in the latter directions that organisation is less effective. There is a very common expression in the South-eastern counties of England to

the effect that 'a good laying hen is more profitable than a breeding ewe.' This is the result of long experience. What is meant by this statement is that the hen through her progeny returns more money than the sheep, considering the land occupied. For example, a farmer in West Kent keeping fifty hens, sold chickens in one season to fatteners to the amount of £87. That gave an average of 35s. (8 dollars, 40 cents) per hen, which would be a good average for a sheep. The latter would require a much larger area of land, so that the saying is fully justified. The amount named is gross. Deducting the cost of feed and labour the margin of profit in such cases is large. The result was determined by the fact that there is under these conditions a constant demand and good prices. Where that is the case this branch can be commended to farmers and cottagers. The methods adopted should be conducive to early laying and hatching, securing a succession of chickens from January to June or July. Properly managed there is no reason why an annual return of £2 (10 dollars) per acre should not be realised in this manner, additional to the general work of the holding.

Allotments.—With smaller occupations falling under this designation poultry should be supplemental to some other source of income, or the standard of life will be somewhat low. In this respect there has been great advance within recent years, due to adoption of systems which conduce to high production and to higher prices for eggs and poultry. There are many instances where upon four or five acres by diligent attention to the stock a fair living is being made. That is, however, where there is a good market at hand with satisfactory prices. Under such conditions there must be rigid economy in equipment and feeding. The chief danger is overcrowding which results in tainted soil, in itself responsible for many failures. That may not be evident during the earlier years. It will certainly result in process of time unless care is taken from the outset.

Much can be accomplished by systematic management on these small areas of land. Some of the most successful breeding farms are operated on what are really allotments. Where there is greater range available the methods recommended for small holdings should be adopted, that is, a four course rotation. There must be change of runs, so as to give the land a rest, and by cultivation turn the manure into

money, at the same time purifying the soil. Many instances could be quoted of praiseworthy attempts to develop poultry-keeping which ultimately failed from the fact that losses arose through disease and reduced productivity due to absence of some such method as here indicated.

Burnley and its Allotments.—For generations the denizens of Lancashire and the West Riding of Yorkshire have been keenly interested in poultry. Here are found manufacturing villages in and around which allotments almost entirely given up to fowls are to be found in large numbers. During the present century poultry husbandry has increased in the first named counties more than in any other part of Britain. In many respects the methods adopted have been on similar lines to those found in some districts of Belgium, and in the Eastern and Western United States. In this development farmers have shared to a very large extent. Our purpose is to refer to what has taken place in one section of East Lancashire, around Burnley, which manufacturing town is a hotbed of poultry enthusiasts, who have done wonders in spite of not a few difficulties. These are usually workers in the cotton mills. Poultry form an additional source of income—an important factor in a form of industry subject to great fluctuations. They have succeeded in spite of having to pay high rents for the allotments. The soot-coated soil does not at first sight appear to be desirable for fowls. By careful management success has been achieved. The methods adopted are ingenious in the extreme, utilizing the land to the fullest extent. As many as 400 birds, old and young, have been kept on half an acre, and 34,500 eggs produced in twelve months. That did not continue, as it was too intensive. Much, however, of the space available is occupied by scratching sheds, and the runs are often covered with fine ashes which are removed regularly. Thus the risk of contaminated soil is reduced as far as possible. In some cases cultivation is combined with poultry-keeping, and the men are skilled gardeners. It has been found that after a few years occupation by poultry a rest must be given to the land. Even with all precautions known, there has been less success than in the earlier years, and the stock became less productive. Owing to the difficulty of removing the buildings and that of securing convenient land there has been a temptation to take risks that are undesirable. What is here stated has come to be

recognised, which is all to the good. Prior to the Great War a similar system was general around Renaix in Belgium, an industrial town. There, however, more was done in cropping the allotments. The risks of contaminated soil were realised.

REFERENCE.

(1) Report on the Poultry Industry in Belgium, by Edward Brown, F.L.S., (London, 1910).

CHAPTER XX

BREEDING PLANTS AND FARMS.

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BREEDING PLANTS AND FARMS.

INFLUENCE OF BREEDING PLANTS—SUPPLEMENTAL PRODUCTION—SMALL AND LARGE PLANTS—EQUIPMENT—EXHIBITING—LAYING TRIALS—CLASS OF STOCK—SALE OF STOCK BIRDS—VALUES—COSTS OF PRODUCTION—PRICES OF STOCK BIRDS—PERIOD OF DEMAND—EXPORT TRADE—EGGS FOR HATCHING—SELECTION AND PACKING—DAY-OLD CHICKS—HATCHERIES—PLANT FOR DAY-OLD CHICKS—COST OF PRODUCING DAY-OLD CHICKS—CHICK BOXES—WEANED CHICKENS—PUPILS.

Breeding plants have the same relationship to poultry husbandry as the seed grower to the farmer, and the nursery gardener to the horticulturist. They are necessary to its development and continued success. These have increased enormously in number during the last generation. Many of those who took up this branch have made large incomes, in some cases fortunes. For such as have the necessary skill and application the opportunity in this direction is an increasing one. Understanding of the laws of nature as far as known, careful application of these, great patience in waiting for definite results, and grasp of what is required by ordinary poultrymen and women, whether farmers or specialists, together with a rigid standard in respect to vigour and qualities of what is sold, are all requisite. There can be no doubt that poultry husbandry has suffered much at the hands of its friends. Generally speaking it is thought that poultry farms are chiefly concerned with production of eggs and poultry for human consumption. Not a few of those so-called are breeding plants, which is the more correct designation. On some of these exhibition is combined with other operations, such prizes as may be won acting as an advertisement. A further point is that a large number of breeding farms are limited in scope, and that there is a weakening of the stock

by overcrowding and restricted conditions. In that respect great advance has been made. The need for range is better understood than was formerly the case.

Influence of Breeding Farms.—The place of these centres in relation to poultry husbandry is of the utmost importance. They are essential to further development, and that *pari passu* with increase of poultry upon farms, small holdings, allotments, and elsewhere, so will the need for these correspondingly advance. They have, therefore, an important function in promotion of the industry as a whole, and in more complete realisation of the national food resources. Formerly farmers and others when purchasing fresh stock, that is, where seeking by purity of race to raise the standards of racial quality and productivity, could only do so from exhibition breeders, who thus found a profitable outlet for their surplus birds and eggs. Where egg or flesh quality was given due consideration in selective breeding the results were satisfactory. That has all the time been evident with some breeds. Wherever there was exaltation of abnormal characteristics and disregard of economic qualities, the results proved unsatisfactory. As stated by Professor Eugene Davenport, 'when our standards are decidedly against the highest fertility they are dangerous, if not fatal, to the race,' and the same applies to productiveness of eggs or flesh and to constitutional vigour. The result was that there came into being a large number of poultry-breeding plants, some on a very large scale, where the main, almost the only, object was the raising of stock high in productivity. These largely captured the trade once entirely in the hands of exhibition breeders. Within recent years the last named have recognised the importance of greater productivity and, in the more economic and popular races, have given attention to this question, thus regaining some of the ground lost. On the other hand, there has been on the part of not a few specialist breeders a disregard of racial characters, of constitutional vigour, of size of bodies and of eggs, by concentration on numbers of eggs produced, which has been carried to an extreme. In many instances it has been found desirable to resort to exhibition stock even among production breeders. What should be aimed for is a combination of characteristics and qualities. For that is needed the great skill evinced by exhibitors, a clearer understanding of the essential factors, and rigid selection in stock and eggs for hatch-

ing. It should be realised that it is only a modest percentage of flocks which are desirable for reproduction, as that and production are often antagonistic. This branch requires a high standard of qualifications on the part of the breeder and considerable experience. It affords a lucrative field for those who have the resources and determination which are requisite.

Supplemental Production.—Breeding plants contribute to a more limited extent to food supplies. That, however, is mainly supplemental to other aspects. Usually these are run by specialists. There are, however, a few examples of farmers who have taken up this work, as in other branches of domesticated live stock. No reason can be adduced why the number should not be largely increased. Farmers have the decided advantage of opportunity to give their birds abundance of range, and to raise the young stock under the most favourable conditions. The business, however, requires steady and persistent attention, involving a considerable amount of intelligent anticipation, careful study of breeds, and correspondence. The chief danger of specialist plants is attempting more than the land can carry. Some of the most successful establishments prove that this can be avoided, that is, where the principles laid down as to the relationship of animal and plant life are observed. On the more open areas many breeding farms could be operated successfully. The need for wider range is beginning to be understood. If stock are kept in small runs there is a loss of vigour in the progeny. Introduction of the scratching-shed system and better knowledge of feeding have done something, though nothing can take the place of a better environment. The line of success is to commence on a modest scale, enlarging as experience increases and results desired are achieved.

Small and Large Plants.—There are two methods of conducting a breeding poultry farm: First, by concentration entirely upon sale of stock, eggs for hatching, or day-old chicks, in which case all surplus birds other than those required in the breeding pens, or that may be regarded as saleable, are disposed of, so that at the commencement of each new year the number of adult poultry will be at the minimum. This is the plan to be commended to those whose land is limited in extent. To attempt more is frequently to lose all. Under such conditions it is imperative that the runs shall have as much rest from

occupation by poultry as is possible, and be heavily cropped. And, second, by combination of egg-production in larger flocks of unmated hens, with as many selected breeding pens, to supply eggs for hatching either at home or for sale, as can be maintained. Upon farms of a fair size, where the organisation is effective, the advantages are that there is usually a much wider choice of birds as suitable breeders, and that the yearling hens can be kept on during the first year. The importance of not using pullets as breeding stock during their first year cannot be too strongly emphasised. There is a temptation to mate these up during that period. That should be resisted in spite of statements that in doing so no harm has accrued.

Equipment.—That a more expensive equipment may be justified upon a breeding farm, as compared with a plant devoted to egg or poultry production for market, is evident, due to its advertisement value. Potential customers are impressed by good houses and a well laid out and kept place. That is one reason why many stock breeders prefer a plant with all the birds in runs. Wherever possible the preferable plan is distribution over the land, with perhaps a few enclosed yards for special pens. Under such circumstances portable houses are commended. As a fact mobility in these buildings is of great importance, as it enables removal when this appears to be necessary, or desirable for other reasons. Long range houses are suitable for poultry which are only kept as layers, and which will not be bred from. These are economical in first cost and as a question of labour. For breeding stock such is not really the case when ultimate results are considered. Where it is found necessary to keep the breeding stock within enclosures it is of prime importance that these shall be as large as can be arranged, and that the chickens which are in turn intended for breeding shall be reared on range. The limit would appear to be in the neighbourhood of forty to fifty per acre. Even under such conditions, when the breeding season is over, the inmates should be removed, and the herbage, if in grass, be fed off by sheep, or if arable, ploughed and cropped. Double runs are often used, and they are helpful. Also bush and other fruit may be planted as contributory to keeping the soil sweet. The cost of equipment has increased considerably within recent years. On a well built plant where wire netting has to be used it often reaches £1 (5 dollars) per hen per annum.

General View of the Yorkshire Federation Laying Test, Otley, Yorks., England

In no field of poultry husbandry is the essential need more evident for combining cultivation with the fowls than on breeding plants.

Exhibiting.—This aspect of the industry is of great importance. The great majority of those so engaged find part of their revenue by sale of stock, etc. As the prices realised are usually high for fine quality birds the expenditure upon equipment is warranted at a higher scale than on production farms. This is required by the fact that breeding is usually on more individual lines and in small flocks, whilst enclosure in runs is essential before and during the breeding season, otherwise there would be danger of mixing. Some of the most successful exhibition breeders have limited their stock to one or two score birds, each of which was selected with the greatest rigidity, excluding every one that failed to attain whatever standard was adopted. Not only so, but these birds are chosen by their pedigrees as much as by their appearance. The exhibitor is usually well satisfied if ten per cent of his chickens are good enough for the show pen. The fascination of this pursuit is partially due to its uncertainties, and to the constant striving for greater perfection, even though that may sometimes be merely external and not productively.

Laying Trials.*—Nothing has done more to popularise poultry husbandry than the institution of Laying Trials on a competitive basis. It is not necessary to describe in detail the history of laying trials, which were first established in England in 1897. Now they are found in all parts of the world where poultry breeding is conducted on progressive lines. The object, apart from the prizes offered, is to test the laying qualities of the pullets from different breeders under identical conditions, and, by independent operators, recording performance as it really is and not as it is often asserted to be. There is abundant evidence that these trials have led to a great extension of poultry breeding, to the giving of greater attention to selection for production, and to an extension of knowledge and experience which is very valuable indeed. It cannot be admitted that the direct quality of the poultry found throughout the country has been improved to the extent which is frequently claimed. The benefit has been indirect as indicated above. One serious weakness is that for a long time attention was concentrated upon number of eggs laid by individual hens, regardless of the effect of overstimulation upon the physical powers, of lower-

*Plate LXXII.

ing the constitutional vigour, of heavy mortality, of making the birds more susceptible to disease. A further point has been that in the striving for high fecundity, in which respect remarkable results have been attained, there has followed a reduction in size of eggs. The statement has been made that during the last ten years the average size of British, mainly English, eggs has declined by seven per cent and that in this respect they compare unfavourably with the better qualities of imported supplies. The same is true elsewhere. Research has shown, thus confirming experience, that in the cycles of laying a slight, though appreciable, reduction in the size of eggs is noted, and which will be perpetuated in the progeny. A further fact is that in order to attain high records it is necessary to bring the pullets into lay at an early age before they have attained maturity. In this way growth is checked, and there is an increasing tendency towards smaller size of body, which, in turn, leads to smaller size of eggs. Although in both directions the diminution may be small in each generation the continuance of the influence becomes of importance. Careful selection of the birds entered in laying trials for size of body, and in eggs for hatching, would go far, if continued, to counteract the tendencies referred to. Possibly the result might be to lower, at any rate for a time, the average production of hens. If that is a necessity in order to secure eggs which conform to market requirements, which must always be kept to the fore, the ultimate gain will be very great, and counteract tendencies which have been increasingly apparent. That the need to accomplish this is evident is generally acknowledged. There are other aspects of inquiry, namely, whether the serious increase of embryonic mortality and of deaths among growing chickens and adult stock, are not due to debility in the parent stock following upon abnormal fecundity, as indicated in weakness of shell in eggs and loss of important elements in the contents.

From the personal breeder's point of view the great value of laying trials is the advertising value. That is very great indeed. The business of many breeding poultry farms has been built up and is maintained by successes achieved in these competitions. Most notable and satisfactory is the fact that such success is open to all, and that the records made are guaranteed by the fact that these are independent of the breeders themselves. There are many factors involved. There

have been contestants who have won in trials by sheer good fortune, what is called luck. As a rule, not only must there be skill in selective breeding, bringing the pullets to the point of commencing to lay when sent in, but intuition in selection of birds for this purpose which is the result of observation and experience.

Class of Stock.—The amateur or exhibitor may choose the breed or breeds he keeps to please himself, or, which offer the greatest opportunity in the last named direction. The poultryman, however, who caters for a trade in stock, etc., must possess the races which his customers desire and are willing to buy. Therefore it is important that he shall be up to date in his stock. For his purpose, it is useless having the best races in existence if there is an insufficient demand, or the prices obtainable are meagre. Whilst a few breeds are remarkably static, in others changes are constantly taking place. Within our own experience many breeds have had periods of great popularity, when it was difficult to meet demand for them. Then came a lull, and afterwards a decline in public favour. No rule can be laid down for such vagaries. In many instances it has been due to failure to maintain productiveness ; in others it is nothing more than fashion or novelty. It is often true that when first evolved or introduced, a breed is highly fecund, due to change of environment, and that, after a time this is not maintained, and as a consequence demand falls off. New breeds are frequently boomed to exaggeration. Some breeds have held their position to a remarkable degree by the possession of sterling qualities and adaptability. Even with these there are periods of lessened production. After a time they regain their position. The breeder should, therefore, study and even anticipate these changes. On smaller plants it is wiser to concentrate the attention upon one breed. On larger, more may be kept, if the requisite attention can be given to each. As higher prices can be obtained for pure races, or eggs and day-old chicks from these, than for cross-bred, the former are commended.

Sale of Stock Birds.—Primarily poultry breeding farms are engaged in supplying fully-grown birds suitable for stock, which, in many cases, represent the greater part of the trade done. Within later years eggs for hatching and day-old chicks frequently bulk prominently in the returns. An estimate is that in the United Kingdom twelve to fifteen million stock fowls, to say nothing of ducks, geese and turkeys, must

be bred annually to maintain the existing stock of poultry in Great Britain and Ireland, without provision for any increase. The same applies proportionally in other countries. The majority of these are bred where they are destined to live. Considerable numbers, however, are purchased annually by all classes of poultry keepers. That is true with farmers and larger food producers. Amateurs and smaller operators are often compelled to obtain fresh stock by reason of their conditions. Demand is a very large one. As poultry husbandry increases so must the supply. A mistake is often made by expecting that a market can be found for cockerels equal to that for hens. Excepting in a few cases for special reasons it is wiser to make very rigid selection of the males, and to sell the others for consumption, rather than to keep them at considerable cost in feed, etc. As a rule the number of cockerels and pullets bred annually is fairly equal, whereas demand is much larger for the females.

Values.—Formerly the value of a fowl for stock was almost wholly determined by its purity of race and the degree of perfection in external characters. Whilst both of these have an appreciable value, another factor has been introduced, more especially in egg-producing breeds—namely, family records. As a consequence, what are termed pedigree strains have taken the premier place, more especially in respect to productiveness. By that is not meant reliance upon single years performance of a few hens out of a flock, for we should not forget the fact that high fecundity is by no means a new feature, and that what one or half a dozen may do in this direction is no proof that their sisters are good layers, that their own progeny will be prolific, or that the males will be able to transmit this quality. At least five generations are required to justify claims of high fecundity. Quite a number of individuals have been bred and tested which have attained the laying of 300 and more eggs in their first year. That is a remarkable performance. It is, however, no proof of transmitability. The value as breeders is to be determined by the average production of their progeny. In this respect an important fact cannot be ignored, namely, that in laying trials where the great majority of birds are from carefully selected and pedigree stock, the average production in eggs, though in advance of earlier days, has not changed to any marked degree, and that the figures would show an average of about 180 eggs per annum

is a maximum at present. How much of this advance is due to improved feeding and management cannot be stated.

More attention is now being given by breeders to external characters than was at one time the case, without, however, exaggeration. The value of stock is not in any one direction. It lies in purity of race, constitutional vigour, profitable qualities, and age. The breeders who have given the greatest amount of attention in all these directions are those who have succeeded to the highest degree, and are able to command the highest prices in that they can offer the best return for money. There is one direction in which the prices of productive stock, when combined with racial characters, has advanced very largely. To that laying trials have contributed powerfully by the publicity thus given. Extravagant prices are frequently paid for high record, pedigree stock, far in advance of those bred for exhibition. Whether these are justified is questionable, except for their advertisement values. Save in the latter direction, the main factor is, how far can the individual factors be reproduced in the progeny ? Where there are several generations of proved capacity and capability behind a bird, the values are high and the breeder rightly can ask increased prices. Purchase is, however, at all times a speculation in which are considerable risks. There is here involved a moral question. No breeder should ever sell stock, eggs for hatching or day-old chicks, as suitable for stock, which he does not consider desirable for the perpetuation of birds for breeding on his own plant. He is called upon in common honesty to apply the same rigidity of selection to what he sells as to that which he uses.

Costs of Production.—An essential consideration is the cost of breeding, hatching and rearing fowls, or of eggs for hatching and day-old chicks. In the case of birds intended to be sold for stock, that is usually when they are from six to eight months old, if we take seven months as the average the costs can be estimated. Upon general farms, where the birds have abundant opportunities during the growing period of obtaining a considerable part of their food supplies, the expenses of feeding will be less, though not to the extent generally supposed. As, however, breeding farms are usually run on more expensive lines, it is desirable to deal in terms applicable to these. A further point is the number handled in accordance with the expense of labour and equipment, neither of which can be stated in actual figures.

Experiments show that chickens can be grown to twelve weeks at a cost, inclusive of the egg, oil for incubator and brooder, and food, at a cost of about 1s. (25 cents) each. This does not allow anything for potential value of the parent stock, which varies enormously, and especially where pedigree methods are adopted. If to the amount named be added interest on capital, deterioration and renewals of plant, and labour, assuming that operations are conducted on a sufficient scale in respect to number of birds, a fair computation is 2s. (50 cents) each bird at twelve weeks old. From that age the food cost should not exceed an average of 2d. (4 cents) per week, so that at seven months old (thirty weeks) the actual expense will be 5s. (1 dollar 20 cents). To this must be added risks of and losses by disease, and the weeding out of specimens which at an early age reveal arrested development, or for any other reason are regarded as unfitted for breeding. Where embryonic mortality, known as death in shell is high, the sum named would have to be increased. Generally speaking, without allowing any margin for profit, or for management, the prime cost of good breeding stock at the age already named is 7s. (say, 1 doll., 35 cents) per bird, which may be accepted as a minimum. If selection was exceptionally rigid, or the number of birds raised is small, the costs would be higher. The sum named allows nothing for advertising, printing of catalogues, or for other expenditure. Range farmers would be able to rear such stock at least 1s. below the amount named.

Prices of Stock Birds.—One of the most difficult questions to decide is the price to be asked for stock birds. Usually vendors do not err in their appreciation of values. Price is often decided by what people will pay, rather than any actual value. There is no fixed standard. In this connection it should be remembered that the same bird may be worth much more to one buyer than to another. The vagaries of purchasers are puzzling. Even though these do not intend to exhibit, or to compete in laying trials, more money will be paid for stock advertised from a prize strain, or to the winner of a laying contest, than from one not so hall-marked. Popularity means much. If a breed is being boomed or written up, a demand is thus created which considerably enhances realizable values, so long as the furore continues.

In this respect reputation is of great importance, as in all phases of life. A well-established breeder who has made a name can always

obtain better prices than those who have their position to win. Some breeders find it more profitable to sell their stock to the bigger men than undertake direct trade themselves. Where the stock of the former came from the latter the system can hardly be condemned. If not then it is dishonest, unless that fact is explained to the purchaser, who assumes he is buying birds bred and raised by the vendor. In that case the seller is a vendor, not the breeder. A variation of method is by placing out selected pens on farms, buying in the chickens at fixed rates. Under these conditions it is really distribution.

Buyers are now more than ever before prepared to pay good prices for stock, etc. They have come to recognise that a good bird requires no more to keep than one which is inferior, and that, generally, the way of higher production is by means of stock that has a record of breeding extending over several generations. Well-grown, typical and healthy birds cannot be sold at six to eight months old, allowing a moderate amount of profit, for less than 10s. 6d. (2½ dollars) each. Such an average might pay the breeder who only regards his poultry as a supplementary pursuit. The man who expects to make a living out of the business, and who adopts pedigree breeding, trap-nesting, etc., cannot sell at that figure. In accordance with his reputation he can command much higher prices, and deservedly so, without attaining the fancy prices paid for exceptional stock. Cocks, or cockerels are usually 50 per cent higher in price than females. The latter can only influence her own progeny, whereas a male will exert his influence over the chickens from every hen with which he is mated. Moreover, he costs more to produce. A further point is that hens in their second year, which have not been used for breeding in their first season, are more valuable than are yearlings. Males are not directly productive as are hens, and have to be fed and maintained up to the time of mating, which may mean an increased cost of fifty to seventy-five per cent. It is a mistake to prefer young birds because they are cheaper.

Period of Demand.—In the Northern Hemisphere the season of sale of stock birds extends from September to February, though there is demand to a lesser extent at other periods. Many of the more systematic breeders strive to dispose of the bulk of their saleable fowls by Christmas. At the same time they usually have a number of birds in excess of their actual requirements, which are available to meet

the Spring demand. Those who buy late must expect to pay more than during the autumn. One explanation for use of young stock for breeding is that these are cheaper. That, however, is false economy. The wise policy to adopt is to depend for breeding stock upon second and third year birds, even when purchased in the yearling period.

Export Trade.—For a long period of time Britain has been the leading country for supply of breeding stock to other lands. The reasons for this have already been suggested, namely, climate and diversity of natural conditions, such as soil and altitude. Owing to the advancement of poultry breeding in other countries the competition is much greater. To some extent British breeders have been depending upon their reputation, which is a mistake however high that may be. In earlier days the demand was principally for exhibition stock, for which very high prices were paid. With the steady, even rapid advance of production poultry, and the increasing number of breeders, the competition is very keen in some of the more popular races. Britain still holds the field in fancy or exhibition poultry, though in this respect changes are taking place due to different standards. In some instances, notably in Canada, official recognition is given, after inspection, to stock, which is attractive to buyers. A further reason for loss of trade in production poultry is that in striving for high production there has been a disregard of racial characteristics with, in some instances, a loss of type. Buyers, and especially in countries where the number of exhibitions is small, and characters received consideration to an equal extent with production, the appearance of the birds is more in conformity with the ideals of the breed than where number of eggs, for example, are considered everything. Appearance has an important value in this trade.

With attention to what is here stated this business is capable of great increase. To succeed the special considerations are, never to sell a bird for export that would not be regarded as good enough for breeding in the place of origin, to take the same care in selection with regard to breed character, type, and constitutional vigour as if it was to be used by the breeder, and always to ship in good condition. The aim should be to satisfy the customer.

For export special packages have to be provided, giving the birds sufficient space and enabling them to be fed and cared for *en route*.

Appliance firms supply boxes and coops which have proved satisfactory on even the longest voyages, and the shipping companies quote terms for delivery almost anywhere. Attention to the birds on the voyage is secured by a payment to the cook or butcher on board for every one that he lands in good condition at the end of the journey. Those forwarded to the nearer European countries are usually sent in poultry hampers. One fact to be regarded in shipping south of the Equator is that the breeding seasons are opposite to those north of the line ; therefore, it is desirable to allow birds to mature more fully than is usually the case with those sold in the home or nearby countries.

Eggs for Hatching.—One of the cheapest methods of renewing stock is by the purchase of eggs for hatching every year, either as supplemental to such as are brought out on the place, or as supplying the whole of the fresh stock required for replacements. The trade done is very large, although to some extent it has been displaced by day-old or baby chicks. Some of the larger breeding farms dispose of hundreds, perhaps thousands, of sittings of eggs every season. Further, not a few of those who operate on a more modest scale derive a considerable portion of their returns from this trade. That the system has contributed greatly to development of poultry husbandry is unquestionable. A profitable outlet is thus obtained for surplus eggs beyond those required for hatching on the place of origin. Returns by sale of these eggs are much higher than for consumption, and at the season when production is at the maximum. Also purchasers are able to obtain fresh stock at lower rates than would be the case if breeding birds were obtained. As a rule the price of a sitting of eggs is about the same as, or even less than would have to be paid for a single bird, and from such sitting six or eight chickens may be hatched and reared. Our own first success was due to purchase of a couple of sittings of eggs. Small poultry-keepers who are compelled to keep their fowls in strict confinement, and have no male bird, by buying a setting of eggs annually can usually maintain the virility of their poultry.

This branch is very profitable, for the reasons stated, and can be commended to those engaging in poultry husbandry. There have, however, been many complaints on the part of both vendors and purchasers. The system lends itself to trickery on both sides where there is a disposition to such practices. Seasons, also, have much to answer

for. Travelled eggs do not generally give the same standard of hatchability as if they are incubated on the place where produced, owing to their delicate mechanism. Transit involves liability to shocks and rough treatment, and to exposure, frequently causing rupture of the contents of the egg, and without any damage to the shell. That is specially the case with eggs from highly-bred stock or those kept under intensive conditions. The trade is one which, however carefully conducted, renders the seller liable to many complaints, for which reason some breeders refuse to engage in it. We have known eggs changed whilst *en route*, and the vendor was charged unjustly with fraud. Customers are at times unreasonable. They buy eggs and expect chickens. All that can be promised by the vendor is that he will exercise every care in selection and dispatch. Even he cannot be sure, when he sets a batch of eggs, that there will be a good percentage of chicks hatched. In selling eggs for hatching, he transfers to his customer for a money payment the chances, such as these are. At the same time it is his business to see that the purchaser has a reasonable opportunity of obtaining what he has paid for. In order to afford a guarantee, the practice is general of replacing infertile eggs, if returned when tested. That is fair to both parties. If an egg is fertilised the responsibility for non-hatching should be that of the purchaser. It may be due to bad management of the buyer, to the hen under or the incubator in which it is placed. Fair, and even generous, treatment, however, pays in the long run.

Anyone taking up this business must be in a position to supply eggs for hatching at the time these are in demand, which, except for special purposes, usually extends from January to the end of May. From mid-February to the end of April is when demand is at the maximum. On a well-managed plant all the birds, even two and three year old hens, should be in profit by the first of February. For earlier production it is often necessary to mate up pullets. A great amount of loss arises by selling eggs for hatching and day-old chicks from eggs laid by immature stock, which are lacking in constituent elements and vitality. One important factor is that the birds producing the eggs shall be kept under conditions that are conducive to constitutional vigour. Keeping on range is most desirable. Such, however, is not always possible. Where kept in enclosures, these should be sufficiently large, and be

double so as to enable the soil in rotation to be rested or cultivated. To promote exercise scratching sheds are invaluable. It is also desirable not to place the hens in runs until near the time when their eggs are required. If more than one breed is kept care must be taken to supply eggs from the race of fowls as ordered, and also from the specific pens where these are differentiated. The practice of placing out breeding-pens with farmers and others has much to recommend it for the conservation of vigour. It involves risks of neglect in keeping the eggs apart.

Selection and Packing.—It has already been explained that all birds bred are not fitted for reproductive purposes. In the same way, every egg laid is not necessarily suitable for hatching purposes, even though it be strongly fertilised. Those who sell eggs for hatching are in honour bound to select as carefully eggs disposed of as would be the case in their own incubation. Nothing conduces to loss of confidence so much as receiving of a lot of undersized, misshapen, or weak-shelled eggs. The temptation is a real one. An egg for hatching may be worth ten to fifty times its value for human consumption. That must, however be resisted.

Very important is the question of packages. Sellers of cheap eggs frequently despatch in small boxes, using hay, even sawdust, as packing material, as a result of which the risks are considerably increased. Boxes are liable to jars and shocks. There is no spring or yielding in them. It is not the fall that hurts, but the sudden stop. Special egg boxes are sold by appliance makers, many of which are excellent. In some of these corrugated paper is used between the eggs, and felt above and below. A good form is that of cardboard, with a section for each egg. As the package is yielding it generally carries the contents safely. The main thing is to have a cushion, so that if the package falls the impact will be reduced to a minimum. The best form is in roomy baskets, which entail more trouble, yet is worth the labour. At the bottom should be placed a layer of soft hay, then each egg is wrapped in hay and so bedded that all are firm. Hay between the rows, and a cushion of that material on top will, when the lid is tied down, make a package that will carry long distances in perfect safety and yield the best results. In cooler weather it is desirable to also first wrap each egg in paper. Whatever the package, it should be

boldly labelled "Eggs for Hatching," which usually commands greater care *en route*. Experience is not in favour of sending eggs by Parcel Post, except where the Postal Authorities make special provision.

Prices of eggs for hatching vary considerably. The reputation of a breeder, value of the stock, popularity of the breed, and class of buyers, together with the season when sold and the number bought, have all to be taken into account. What people will pay is generally the determining factor.

Day-old Chicks.—Reference has already been made in Chapter XVI. to the remarkable developments of a trade in day-old, or baby chicks, which has grown enormously within recent years. In France, where the system originated, and Great Britain, although there are a few central hatcheries, as described below, the trade is chiefly in the hands of breeders, who are thus able to control the stock. The greatest development has taken place in North America, where hatcheries are operated on an extensive scale. Such plants are referred to later. In all cases the important consideration is a regular supply of hatchable eggs from which vigorous, productive chickens can be hatched. To that end the breeding stock must be possessed of constitutional vigour in the highest degree. Breeding from immature and enfeebled stock, forced to secure early laying, or kept under bad conditions, is fatal to the hatchability of eggs, and to the liveability of the chickens which may be brought forth. Where the parent stock are carefully selected and are kept upon free range, the opportunities in this direction are very great. From the buyer's point of view the day-old business is of considerable value, enabling him to be assured that he is obtaining birds and not the mere promise, as when eggs for hatching are bought. Generally the price of chicks is double that for hatching eggs, which is reasonable. He has not to undertake the trouble and risks inseparable from the hatching process. Further, if able to obtain chicks when desired, the work is expedited by at least three weeks as compared with buying or hatching eggs from his own stock. The success of this system entirely depends upon supply of eggs from reliable sources, and when these are required, otherwise the business will fail. That is more difficult than is generally realised. Where the day-olds are sold as chicks and nothing more, that is, without any guarantee as to breed or quality, the output is usually a very mixed one. That,

in these days is not enough. Purchasers are out to obtain pure races of poultry in the first place, and those which are either from good layers or capable of rapid growth for the table. We have here an explanation why, in Europe, sale of these small birds has been largely in the hands of owners of breeding poultry farms who use either their own stock for supply of eggs, or control more or less those who contract to supply them with the eggs required.

Hatcheries.*—As an indication of what is involved where operations are conducted upon a large scale, may be explained that the question resolves itself into two phases, first, obtaining a supply of suitable and fertile eggs for hatching at the right seasons; and, second, establishment and conduct of the hatching plants. The latter is dealt with below. With respect to the former, experience has shown that with the improvements made in respect to mammoth incubators, chickens can be hatched in large numbers for sale as day-old or baby chicks; that an enormous demand has been and can be created on the part of farmers and poultrymen generally for these small birds; if these can be obtained at a fair price renewal of stock by this method is economic; and that success or failure is entirely dependent upon the nature and quality of the stock from which eggs are obtained, equally as to breeding qualities, productivity, environment, hatchability, and liveability. Experience in America and Europe has clearly shown that where such eggs are obtained from selected birds kept upon range, the results are excellent, but that if drawn from yarded and intensively kept stock the reverse is found. Hence it is that Hatcheries should be placed in rural areas where supplies of eggs can be obtained from breeding stock kept under natural conditions. In the larger establishments, several of which have each egg capacity from 100,000 to nearly millions, it would be practically impossible to run a farm able to meet these requirements. For the former number of eggs ten thousand hens would be required to keep the machines fully operated.

It is evident that to carry out such a project effective organisation and administration are essential. The capital required for equipment is much less than if a breeding plant were part of the scheme. The time of buying the eggs to turning out the chicks need not exceed four weeks, whilst the labour costs for operation are comparatively small. A portion of the staff is employed in securing and supervising the supply of

* Plates LXXXIV and LXXXVII.

eggs. A Hatchery with capacity of a hundred thousand eggs does not need a building whose cubic capacity exceeds the requirements of a thousand hens, and may be less if the forced draught system is employed. In this respect, however, it is desirable to have sufficient space. Air is as necessary as heat for incubation. Provision for extension is desirable.

Such scheme to be successfully conducted involves the organisation for supply of eggs from stock which can be guaranteed as to racial and productive qualities, and the conditions under which these are maintained, otherwise there would not be that improvement which it is the object of the Hatcheries to obtain. Such guarantee is and must be that of the owner of the Hatchery. He sells and is responsible to purchasers. It is his business to see that the eggs which he obtains are of the quality desired and maintained on right lines. Usually he exercises considerable influence as regards the stock and methods adopted. Only in this manner is he justified in paying the higher prices which will make the work profitable to the breeders. As a rule, however, the chicks thus sold are not the highest class of stock. Those who wish for birds above the ordinary quality must buy from specialists who operate on more modest lines, and who only use their own eggs for hatching. One important influence to be noted is that the Hatchery makes for a great improvement in the poultry found in a district, for obvious reasons.

In order to establish a Hatchery, and as a first step, the co-operation of a sufficient number of breeders, farmers for preference or such as can give free range to their stock. These should undertake to adopt conditions that are mutually agreed upon, and to supply eggs to the Hatchery during a stated period on terms which are fixed. In the great majority of cases there should be rigid supervision in selection of the stock and its mating. Upon that success will depend very largely. Also inspection is necessary from time to time. The following have been approved as regulations for the supplying farms in America. So extensive is the development that official inspections are adopted, and Certificates issued where that is satisfactory.

No breeding birds other than those passed by an authorised inspector may be kept in these flocks during the hatching season. All birds must be pure-bred.

Only one breed or variety shall be allowed on a farm, unless there is ample provision to keep them separate.

Each bird mated must conform in a reasonable degree to the Standard for the breed and variety as set forth in the American Standard of Perfection.

Each bird must conform to a reasonable standard of production.

It must be strong, vigorous and healthy, and if disease breaks out the affected bird must be at once removed.

Close breeding shall not be practiced, and a statement of the name of the breeder and the blood lines shall be made known to the inspector.

Plant for Day-old Chicks.—The successful operation of incubators has afforded an opportunity for development of this business. Selling a hen and her brood was practiced for generations. Such, however, was on a small scale. There is no other method than use of incubators for conduct of such an enterprise, equally as to costs of production, and enabling chicks to be hatched early enough and continuously during the season to satisfy demand. Apart, therefore, from what may be termed the breeding plant, or organisation for adequate supply of the right class of eggs, incubator capacity is necessary in relation to the trade intended to be done. Particulars of such equipment are given in Chapter XXVI. Usually the work is concentrated within twenty weeks. In practice it is found that every machine, allowing for three or four days interval between each hatching, can be operated five times in a season. In the case of ducklings, which take a week longer, we can only expect four hatches. Formerly it was found that, roughly speaking and allowing for infertile eggs, death in shell, accidents, and malformed chicks, two eggs were required for every liveable chick produced. Owing to the serious increase of infertility and of embryonic mortality, that average is much too low. On not a few of the semi-intensive breeding farms, and especially where striving for high fecundity has been carried to an extreme, four or five eggs for one chick may be required. That involves a greatly increased cost. A safe computation is that for each thousand chicks to be hatched three thousand eggs should be incubated. To the extent that the results are more favourable the returns and profits will be increased.

Cost of Producing Day-old Chicks.—The actual costs involved in production of chickens can to some extent be approximated. So far

as eggs are concerned, costs are dependent upon many factors, inclusive of fecundity. The period of the year for the day-old chick trade is when ordinary market eggs are at their minimum of price, although these are much higher in January and February than March to May. Where stock are maintained which have been carefully bred and selected, and to which special attention is given, the eggs produced by them are of much greater value than those from ordinary stock at free range on a general farm. That fact has, therefore to be taken into consideration. A further point is, whether such eggs are in demand for hatching purposes and at what prices. For example, if a breeder has a demand for eggs at, say, 12s. 6d. (3 dollars) per dozen, and he decides to hatch these and sell the chicks produced, he would be justified in expecting twice the amount named per dozen, otherwise he would be a loser, especially when there are taken into account increased risks, additional labour and capital. Experience has shown that the costs of operating hatching plants where labour is either personal and not charged, or is fully occupied, can be safely computed at 2s. (50 cents) per dozen chicks hatched. To this amount has to be added the cost or value of the eggs incubated which, as already indicated, is very variable. That must be decided in each individual case in fixing prices, as must be the number of eggs in relation to the chicks produced. Usually the higher the potential value of the eggs the less satisfactory is the hatching. Most Hatcheries operate chiefly with farm eggs which give good results by reason of their stronger and more vigorous nature.

Chick Boxes.—In order that the chicks shall be able to bear the journey, it is desirable that they be bred from vigorous stock. Some breeds stand transit better than do others. As a result of long experience it has been proved that when they are properly dried off, and have recovered from the strain of the hatching process, which will be about twenty-four hours after their emergence from the shell, they are best able to travel. This is helped by the fact that a chick does not need any food for 60 to 72 hours after hatching. Not until that period has elapsed will they have absorbed the contents of the yolk sac, before this is accomplished supplied food is more than risky. Digestive troubles, which may supervene in death, arise from attempts to induce the youngsters to eat. For dispatch chicks should be packed in wooden or cardboard boxes, of which many suitable makes are sold.

These need not be described as they are advertised, and improvements are constantly being introduced. It is important to provide sufficient head room, to have ventilation holes which will give access to air without draught, and in the larger boxes holding fifty or one hundred birds these should be divided by partitions so that not more than twenty-five are in each compartment. Strips of wood should be affixed to the top and bottom of the box so that there may be circulation of air if these are packed together. Inside there may be placed some cut chaff, and for very long journeys a little canary seed, dari, or hempseed may be scattered for food in case the birds require a supply. When the weather is cool it is found desirable to use canvas, or soft calico, under the lid to hang loosely over the birds. It is not satisfactory to dispatch chicks when the temperature is very low, especially by rail, unless protection can be assured, as the risks of exposure are considerable. In America, where the traffic is a very large one, special arrangements are made by the U.S. Postal authorities for conveyance of baby chicks, and with success. Elsewhere it is generally found that dispatch by rail or express is to be preferred. The box should bear a label bearing the legend, "Live Chickens. This Side Up. With Care."

Weaned Chickens.—Within recent years there has been a growing trade in chickens either at the age when these leave the brooders, say, at six weeks old, and up to three months. That is hardly possible in connection with Hatcheries or where operations are on an extensive scale, for the reason that the object with these is to dispatch the birds as soon as possible, otherwise equipment and labour would require to be increased. It is, therefore, mainly confined to high class breeders whose output is moderate, and who are able to devote the necessary equipment and land, together with labour, to the rearing as far as stated. That there are great possibilities in this trade is evident. The advantages to the purchaser would be great, in that he would thus obtain birds the vigour and virility of which had been proved. Further, he might be able to buy in accordance with the sex as well as the age. The sex of day-old chicks of pure races cannot be told. At the ages named this would be discernible. So far as the producer, that is, the breeder, is concerned, such arrangement would add considerably to the cost of his equipment and labour, and he would require to be

compensated by higher prices than if the birds were sold as day-olds. His customers would usually wish for pullets, in which case he would have to find a market for the cockerels. How far such trade can be made economic to breeders and their customers has to be tested more fully. In the light of present evidence it is specially adapted to pedigree breeders who can command prices adequate to meet the enhanced costs.

Pupils.—There is no question that many poultry farms, so-called, exist on the fees of pupils rather than the sale of what may be produced upon the place. It has been even known that pupils have been advertised for and taken before the farm was actually in operation. The object was evidently to obtain fees and cheap labour. Where the owner is a qualified poultryman and knows his business, a learner may find the experience in building up a plant most valuable for his future work. Under such conditions, however, he should be engaged as a worker and be paid for his services. Before anyone is justified in taking pupils, whether a premium is required or not, the question as to what can be given in the way of experience and practice should in all honesty be asked. Unless these are capable of preparing the pupil for the future, of indicating system and knowledge of the various operations, the time of the worker is spent in vain. When a farm, whatever the branch of poultry husbandry it may express, is well managed on definite lines, equipped on an adequate scale, and is commercial, that is, a business not a mere hobby, there is much of importance that can be imparted. The earnest student or learner will find the time thus spent of the greatest value, especially where operations are on a fairly extensive scale and there is plenty of work to be done daily. In this way breadth of outlook and experience are obtained. What the owner should do is to give reasons for his methods to the learner, and look upon the arrangement as an apprenticeship in which he is responsible for progress of the pupil. His reward is in the fees and labour thus obtained, which is not so great as generally supposed. At first pupils require very careful supervision. One act of carelessness may involve greater loss than his fees will pay in a twelve-month. There are few, if any, poultry farms which embrace the entire gamut of operations. Hence, it is desirable that pupils should be advised to prepare themselves by the widest possible experience.

CHAPTER XXI

INTENSIVE AND SEMI-INTENSIVE POULTRY HUSBANDRY.

View on a Poultry Ranch, Petaluma, Calif., U.S.A.

(Favoured by Climate and Conditions in no other area has Poultry Farming been developed to the same extent as in Sonoma County, of which Petaluma is the hub)

CHAPTER XXI

INTENSIVE AND SEMI-INTENSIVE POULTRY HUSBANDRY *

LIMITATIONS—MEANING OF TERMS—"BIRD-CAGE METHODS"—INTENSIVE HOUSES—THE COMMERCIAL ASPECT—LARGE INTENSIVE HOUSES—SEMI-INTENSIVE HOUSES—UNIT OF FLOCKS—EFFECT OF SYSTEM UPON STOCK—THE APPLICATION.

Under modern conditions of life, due to increase of the world's human population and greater demand for food supplies, and especially with congestion in many areas, adoption of non-natural methods of production involving intensification, is a necessity. The difficulty is in dealing with living creatures to discern the limitations, for such there undoubtedly are, more especially on the side of reproduction. That, in large measure, is on a totally different plane to production. In the latter direction the field is wider. For example, so far as laying hens are concerned, these may be kept under intensive conditions, and prove profitable, if the birds are killed off and not used for breeding when the time of profit is ended. Also, with raising poultry of almost any species for supply of meat, the same is true. It is where the attempt is made to combine reproduction and production that the difficulties arise. Since the rise of poultry husbandry in the mid-years of the Nineteenth Century there have been many attempts made to apply what may be regarded as factory methods to this pursuit, all of which have failed, from the fact that essential natural factors have been ignored. As a result what is termed semi-intensive poultry husbandry has been adopted and with a considerable amount of success.

Meaning of Terms.—The word intensive indicates increase of degree —the raising of whatever is concerned to a high pitch. As applied to breeding and food production it means enhancement within any given environment. With all cultivation and stock breeding there

* Plates LXXIII and LXXVIII.

must be more or less intensification, as compared with natural methods. Domestication is necessarily intensive, varying, however, in degree. In respect to poultry the word intensive refers to conditions under which the birds are kept where certain of the elemental natural factors are absent altogether or reduced to vanishing point. Nearly all exhibition breeding is more or less intensive. Usually, however, the number of birds kept on a given area of land or bred annually is comparatively small. Profit depends upon quality rather than quantity. Where success depends upon the relative output of marketable products, it is the volume which counts. In this respect the two main factors are, first, the influence of intensive conditions and environment upon the body and functions of the birds. Our knowledge in this direction is very limited. Moreover, experience has been varied in the extreme, probably due to influences which have not been recognised. Second, with cultivation, intensification can alone be maintained by regular replacement in the soil of the elements upon which plants live and grow. With respect to poultry, accretion of manurial elements and an exhaustion of other constituents are the chief dangers. What is known as the "soiling system" in cattle may be applied to poultry in the houses or by removal of the earth affected by manure. That does not, however, replace what may have been lost.

Intensive poultry husbandry is where the fowls or other species are kept either entirely in houses or within very small enclosures, and the number in either case is relatively large for the space occupied. It is the last named which determines the degree of intensification, not whether there be six or six hundred under one roof.

Semi-intensification is an endeavour to combine concentration in number with a moderate amount of outside run. Under such conditions the birds are usually in large flocks, though that is not necessary, for each of which is provided a scratching-shed house, with which are connected an outside earth run or runs. The fowls are fed almost entirely under cover. A considerable part of the manure produced by them is deposited within the house, and removed. The quantity added to the soil outside is thus greatly reduced. The runs provide an amount of exercise beyond what is obtainable when the hens are scratching among the litter. Both intensive and semi-intensive methods depend for success upon the activities and exercise of the fowls.

"Bird-Cage" Methods.—The urban or suburban poultry-keeper has no choice. He must enclose his fowls within small areas, and by expenditure of labour, by adoption of methods which would not be profitable on a commercial basis, and by extreme care in feeding, as well as by frequent replacement of stock, endeavour to keep his stock healthy and productive. It is from first to last a question of hygiene, sanitation, and feeding. There are two ways in which the system can be applied. One is the use of a small house to which is attached as much run as can be given, digging up the soil regularly and replacing it from time to time. The other is by keeping the fowls entirely within a small erection as described below.

The fact that there has been so large a growth of back-yard or back-lot poultry-keeping within recent years is sufficient proof that it has been successful, that is, on a non-commercial basis. There are several factors which have contributed to this result, namely, (1) Scrupulous cleanliness. Neglect on this score is, sooner or later, fatal. (2) Using loose sand or dry earth as a floor in the houses, both for the prevention of disease from manurial action and as a means of giving exercise to the inmates, thus militating the tendency to internal body fat. Making the birds work for their food is ever a benefit to them, otherwise they become indolent and non-productive. (3) Use of coarser food to stimulate exercise of the digestive organs. Some doubts have been thrown on the value of dry bran. It is, however, a striking fact that fowls will readily consume large quantities of bran. From this may be assumed that it has a prophylactic action, as distinct from its food value, which appears to be small, and in that respect the instinct of the birds may be accepted as a safe guide. (4) Green food, and fresh at that, is of very great importance. Wherever this can be grown such is desirable. If not, oats may be sprouted by spreading on trays and there watered forming an excellent substitute. These can be easily prepared at any season of the year.

Intensive Houses.—There are many forms of these houses, of which the one best known is single, usually 6 feet long by 3 feet 6 inches deep, and 3 feet in height to the eaves. The roof may be flat, in which case it should be hinged at the back and permit of access to the interior. A preferable form as it carries off rain is to have the roof gabled, the frontal slope hinged in the centre. The front is formed of wire netting,

and may be shuttered. Inside are removable perches and egg boxes. There is usually no floor, and the earth on which the house stands is thickly covered with sand or dry earth. In this grain is buried, so that the inmates have to work for all they obtain. Such an erection is said to be sufficient for six hens, all the time provided that the strictest attention is paid to the details of management as indicated. Double-decker houses have been designed, the lower tier of which has a flat top formed by the floor of the upper tier. That has to be well made and is kept covered with sand or earth. This form has not been found generally desirable. The principle on which these small huts are based involves heavy capital expenditure for the number of birds maintained, and a large amount of labour. The latter does not enter into the consideration of the back-yarder whose operations are limited, and are, therefore, non-economic.

In ordinary poultry-houses, such as portable structures which are frequently removed from one location to another, it is generally accepted that two square feet of floor space, or ten cubic feet of air space, are sufficient to keep the inmates healthy, provided it is fully ventilated. The intensive houses of the size named above have 3½ square feet of floor, and 10½ cubic feet of airspace per inmate which nearly approximates to what is generally accepted as necessary in scratching sheds. There are, however, two important factors to be regarded, namely, that where fowls are kept in portable or semi-intensive houses they are outside the greater part of the day, so that there is not the same sense of restriction, and a greater amount of exercise is thus obtained; and, also, that as ordinary houses have much more head room from the fact that they are usually not less than five feet to the eaves, the circulation of air can be made more regular and effective. There is sufficient evidence to show that for small amateurs and those whose space is very limited these intensive houses can be commended. Everything depends upon careful management and feeding, otherwise there results grossness of body and non-productiveness, as well as a rapid multiplication of parasitic life and loss of virility. Under the first of the above methods it is possible, where space permits, to remove the coops frequently on to fresh ground.

The Commercial Aspect.—Whilst it is freely admitted that intensive methods are successfully applied on "city" or "back yard" lots,

Colony Methods on a General Farm in East Anglia, England

labour does not count, as the operations are on a small scale, it is a totally different proposition if attempted as a commercial enterprise—that is, as a means of living. The former has received encouragement as it adds to the food production of any country. It is the endeavour to develop as business enterprises, large intensive plants by which the system must be tested. Commercially it has not proved to be a success. Perhaps that is most of all due to the effect upon the stock, and from the fact that those who have adopted the system have attempted to breed from the birds kept under these conditions. It is generally admitted that with plant and animal life whilst intensification results in an increase of production, it reduces the forces which are of supreme moment in reproduction. How far highly intensive methods could be conducted on a commercial basis by the purchase of fresh stock, whether as day-old chickens or older birds, in every generation, has yet to be proved, and we do not know of any instances in which it has been successfully conducted on those lines. By use of the small houses as described it is possible to crowd more than a thousand hens in single houses, or fifteen hundred birds in double-deckers, on a single acre of land. What have to be taken into consideration are the capital expenditure, the labour involved, and the increased risks of epidemics and disease generally. At 10s. (two and a half dollars) per bird for housing, which is not excessive, the single houses would cost about £500 (2,500 dollars), and the double-deckers fifty per cent more per acre, apart from other equipment. That, however, is not the greater part, namely, the labour involved. To attend to the cleaning, which must not be perfunctory, the burying of grain, the provision of green stuff, and a host of other details would be a task of no small magnitude. Doubtless the average output per hen would be increased as compared with other systems, at any rate for a time. That this would compensate adequately for the greater costs is very doubtful, as indicated by the numerous failures during the periods when "intensifitis" has become prevalent, almost epidemic.*

Large Intensive Houses.—It is possible that with skilful management, and securing a succession of range reared and vigorous birds, the intensive system can be made a commercial success by use of larger houses. That, in our judgment, will not be by adoption of "bird-cage" methods, or by breeding from the stock kept under these con-

*Plate LXXIV.

ditions. Apart from other considerations, however, the main difficulty has been owing to want of mobility in these big erections, followed in process of time by contamination of the adjacent land. That may be accomplished by cultivation of the soil where the number of birds to the area is moderate, and by the use of scratching-sheds. Any excess in that respect means accumulation of manure, and the land becomes "fowl-sick." Up to the present time nothing has been discovered which will restore to the land the elements lost by overstocking, save absolute and entire removal of the birds for a time. Such has proved to be the case with larger animals, and the same principles apply to poultry. Attention is constantly being directed to this problem. Further, although laying hens can be kept entirely under cover, and prove highly productive, that has its limitations. Birds so maintained should not be used for breeding for reasons already explained. Under such conditions the area per inmate must necessarily be adequate, so as to give space for exercise, and to eliminate as far as possible the sense of restriction.

Semi-Intensive Houses.—With these there is an attempt to minimise the risks which follow increase of numbers on a comparatively small area of ground. The birds can go out of the building whenever they wish to do so. Observations show that most of their days are spent under cover, probably from the fact that they are fed there, and that the soil is speedily exhausted of the elements which the birds desire. The semi-intensive method is inseparable from Commercial Poultry Husbandry. In it success has been achieved to an extent which formerly appeared impossible. The chief factors are in preventing contaminated ground, and maintenance of hygienic conditions within the house itself. To a considerable degree the manure is produced in the house, whence it can be removed. With respect to the ground outside this may be cropped, or planted with fruit trees, which sweeten the soil and afford shelter in hot weather, or if in grass can be eaten off by animals. Profit will depend upon the poultry, which have to bear the entire charges for food, labour, interest on and renewals of equipment, and leave a margin as profit. That is the proof of the economic value.

Unit of Flocks.—With larger flocks, mainly in the direction of houses and labour, the costs are relatively smaller than where

PORTABLE SCRATCHING SHED

(W. H. Colt, Ltd., Bush House, London, W.C.2)

This house is moved on a line track, which is changed as required. In this manner the manure is widely distributed and fresh ground available.

only a few birds are kept together. On the other hand, experience has shown that the smaller the number of birds the higher is the average production of eggs. That, in part, explains the high averages obtained in laying trials by specialist breeders, and also back-yarders, whose unit is from five to half a score. Such system is not economic in respect to food production. The expense involved for equipment and labour in, say, the six unit generally adopted by laying trials is greater than any increase of production will compensate. What we have to discover is the size of flock in which productiveness and costs will bear a due relationship, leaving a margin of recompense to the owner. Generally speaking, under extensive or colony methods this is found to be, for egg-production, twenty-five birds in each house, which has the added advantage that houses of this capacity are portable. For breeding pens the number may be halved. In such cases returns are measured by the chickens obtained, which bear the added cost by reason of increased value.

Many attempts have been made to attain success with flocks of huge size, in some instances up to a thousand birds under one roof. Where these are divided by compartments, although separate houses are preferable, if the flocks are reasonable in number, the system is satisfactory in the accommodation provided. The chief problem is outside on the ground. So far as our observations have gone no instance is known in which these huge flocks have proved successful. On this point there are very divergent ideas. Frequently these are due to other factors which need consideration before a general standard can be adopted. What has appeared to be more generally accepted is that from one hundred to one hundred and fifty offers the best return, taking into account cost of equipment and labour, together with average production. With such numbers it is essential that the house and scratching-shed shall be roomy, be abundantly lighted, and well ventilated. Upon these questions more is stated in the following Chapter. Our own view is that the main reason why smaller flocks are more productive is due to atmospheric influences when the birds are at roost. To a considerable extent the introduction of open-fronted poultry houses has enabled the size of flocks to be enlarged. That, however, has limitations. Massing the fowls in large numbers means that the majority of the inmates are unable to obtain oxygen to the extent required and in a pure state.*

*Plate LXXV.

Effect of System upon Stock.—That the productiveness of poultry can, up to a point, be increased by adoption of intensive methods is within general experience, equally in respect to eggs and flesh. Chickens, ducklings and other poultry attain maturity for killing more rapidly where a measure of what may be termed 'forcing' takes place, that the softness and quality of the flesh is considerably improved by this method, and that, generally speaking, the profit is greater even though the costs are increased. This is also true in egg-production, for reasons which have already been mentioned. In the former instances the birds are killed off when ready. There are no succeeding generations to be affected. With respect to intensive egg-production the same principle applies. Breeding and laying stock should be distinct. In the former reproductive values are primary; in the latter production is all important. Such division is not necessary upon general farms, by reason of the fact that the birds are usually upon range. There is, therefore, not the same risk of degeneracy by abnormal conditions and excessive laying, which are found where methods are intensive.

We have no direct evidence as to the reasons for greater fecundity as a result of intensification. There would appear to be several contributory causes, such as change of environment, more sheltered conditions, stimulation of functional activity by feeding, and that those who take up this side of poultry husbandry usually exercise greater care in selection of their birds than is customary with farmers. The point which has yet to be proved is whether the tendency to loss of constitutional vigour, following upon adoption of abnormal methods, can be prevented or minimised. If the latter alone be true, the result is merely delayed. What is here stated cannot be determined by the experience of two or three years. Many advocates of intensification build up their thesis on the work of a couple of years or less. They have not discerned any appreciable deterioration of the stock. If this system is to become an integral part of poultry husbandry it will have to be organised on totally different lines, by keeping the breeding and laying stock distinct. As Mr. T. W. Toovey has well said, "I feel sure of this, that an open-air life is essential for breeders and for chickens at all seasons of the year." Further, some of those who have tested intensive methods report that mortality in these flocks is much higher, as might be expected, than where extensive systems are in vogue.

The Application.—To recognise whatever limitations there may be in any system is of essential importance. Under semi-intensive methods of Poultry Husbandry these are minimised to a considerable degree, even though they may not be altogether obviated. Where care is taken to maintain hygienic conditions within the poultry houses, to prevent contaminated soil by cultivation or resting the runs, and, above all, by regular and systematic introduction of fresh blood, that is, by stock bred and reared on range, the business has been, and is being, conducted successfully. Any extensions must be by adding to the area of land available, and not by greater number of birds on that in occupation. Semi-intensive Poultry Husbandry affords the opportunity for capable and energetic men and women as a career in life, and for a great increase of food supplies.

With respect to the more intensive methods it should be recognised that the conditions are abnormal, and that the accumulation of tendencies over a series of years will reduce natural vigour and productiveness. As already suggested, those who take up this method should either buy eggs for hatching from hardy stock, or day-old chickens, retaining the pullets raised as layers, and renewing the stock every second or third year. The buying of chicks need cost little more than the purchase of male birds. This plan will avoid the labour and expense of maintaining breeders, hatching, whether by natural or artificial means, and thus reduce the cost of equipment. We may learn from experience with other classes of stock. The town dairyman does not breed from his cows. He buys when these have calved, and sells as soon as they are going dry. The market gardener buys seed and does not grow it. Such, modified to the extent suggested above, should be applied to poultry kept on intensive lines. Ages ago the Chinese adopted these systems in which they are successful to-day.

CHAPTER XXII

PRINCIPLES AND METHODS OF HOUSING.

Buff Plymouth Rocks
(Bred by Mr. Oscar C. Brown, Appleby, Scunthorpe, Lincolnshire, England)
Illustrating the medium-sized, standard-bred, utility type, for egg production, especially on general farms.

CHAPTER XXII

PRINCIPLES AND METHODS OF HOUSING *

ARE POULTRY HOUSES NECESSARY ?—ASPECT AND LOCATION—GENERAL PRINCIPLES—MATERIALS—ROOFING—VENTILATION—METHODS OF VENTILATION—LIGHT—HEATING—FLOORS—PERCHES—NESTS—DRAINING—FARM BUILDINGS—SIZE OF HOUSES—SHAPE OF POULTRY HOUSES—PORTABLE POULTRY HOUSES—SCRATCHING-SHEDS—RANGE OR SINGLE HOUSES—SMALL POULTRY HOUSES—SHELTER-SHEDS—FENCES AND YARDS—HYGIENIC CONDITIONS—ALTERNATE YARDS.

The farmer who desires to extend or develop poultry as an integral part of his livestock, needs to study the conditions under which he lives. When provision has been made by portable or colony houses, and for hatching and rearing, he is equipped for operations on extensive lines. He must, however, observe the principles of housing as indicated in this chapter. It is important the distribution shall be so that the fowls are able to take advantage of shelter as their instincts demand. If one of the farm buildings is used as a roosting place for the birds it must be suitable. Where, however, specialist lines are adopted, as described in the previous chapters, the position selected necessitates careful consideration. In the more thickly populated areas land in a suitable position is not always available, whether for rent or purchase. There is also the dwelling of the owner to be considered. Usually it is necessary as a precaution against thieves that the land and the poultry must be contiguous to the house of the owner. Some places, either owing to an exposed situation, or the nature of the land, are undesirable. Before choice is made, it is essential to inquire what are the conditions at all seasons of the year. A place must not be judged by its aspect during the summer. Convenience in respect to supplies and sale of produce are determining factors that should never be disregarded. In this respect a place of low rental or price may be really dear.

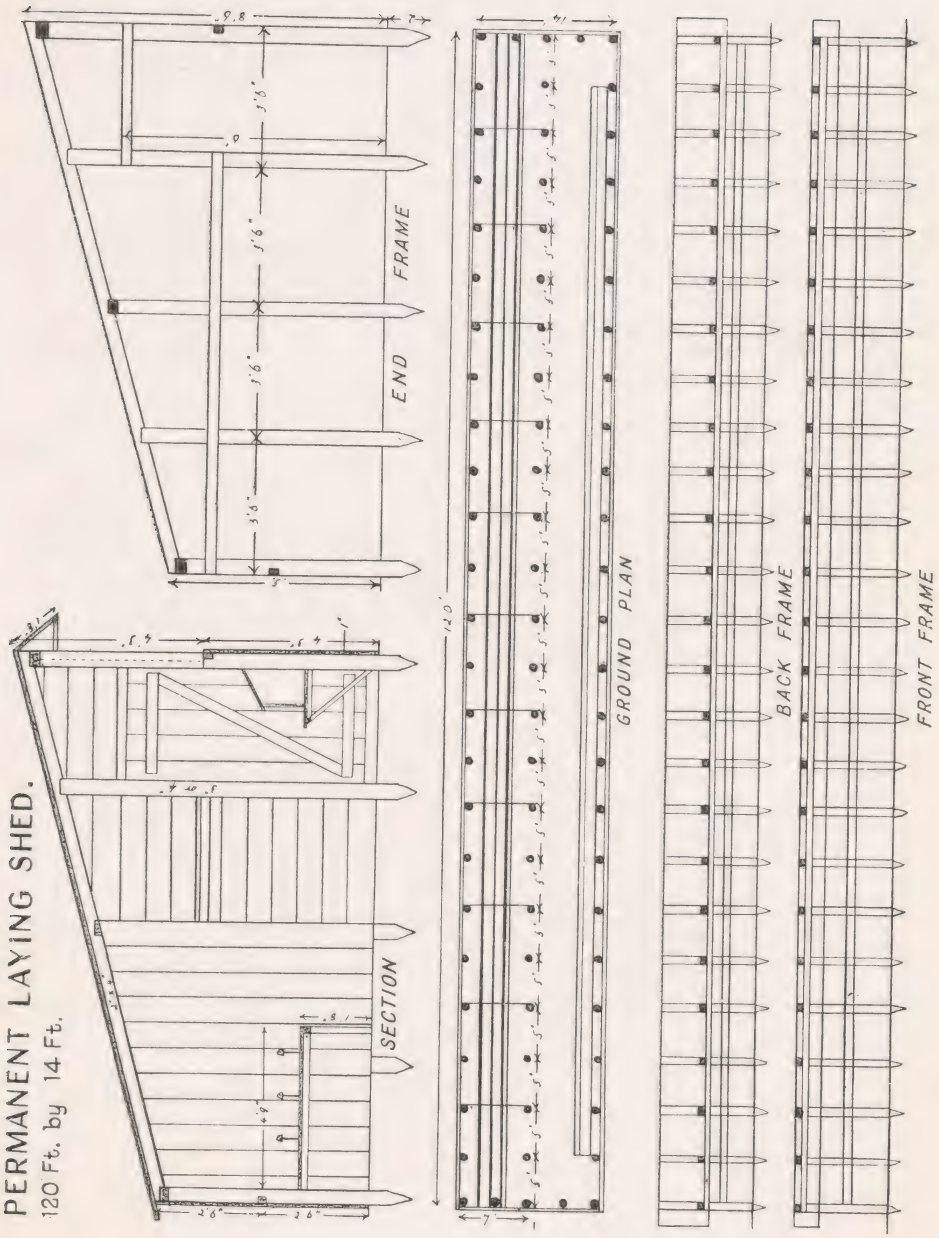
* Plates LXXIV to LXXIX and Plans No. 1 to 5.

Are Poultry Houses Necessary?—Under natural conditions poultry do not use or need enclosed buildings. Such accommodation is due to domestication. Housing poultry is not conducive to greater constitutional vigour. It is protective, affording shelter, more especially at night, and minimises the influences of extremes of heat and cold, especially the last named. It makes for increased egg-production and development of flesh, enabling the attendant to control more effectively the stock. It affords protection against enemies. Domestication checks the migratory instinct, by which, in accordance with the season of the year, a change of habitat takes place.

As a question of health and constitutional vigour, as distinct from productivity, houses are not desirable for poultry. Left to themselves fowls and turkeys would select trees in which to roost, ducks and geese shelter beneath these, removing from one place to another as demanded by the seasons. Such system would mean reversion to the ancestral type, delay in commencement of laying and hatching, and reduction of productiveness. Cases have come under notice in which success has been achieved where birds lived in the open. Those are exceptional, and where the conditions are specially favourable. The lower cost of equipment and of feed meant that a lower average output gave an adequate profit. In some districts, also, absence of trees would make such a method impossible. The balance of considerations is largely in favour of housing. What has to be sought for is the form in which the disadvantages can be minimised to the fullest extent, and the undoubted benefits secured.

Aspect and Location.—Choice of position has considerable influence on the results achieved. The southern slope of a hill is preferable to any other. 'A hill or range of hills has always got several sides or slopes, and as the sun shines in the heavens from east round by the south to the west (in the northern hemisphere), i.e., when he shines at all—it follows that the northern side of a hill, besides being more exposed to the cold storms which come from the north in winter, receives much less of the sunshine, when there is any in our salubrious climate. Indeed, in the winter time, when he is low in the heavens, even at mid-day the northern slopes may never get any sunshine at all. This means a very great drawback to both the plants and the animals of the farm. The pastures on the northern side of a hill are more liable

PLAN No. 1 (SEE ALSO PLAN 5)



PLAN No. 2

BROKEN-SPAN LAYING SHED.

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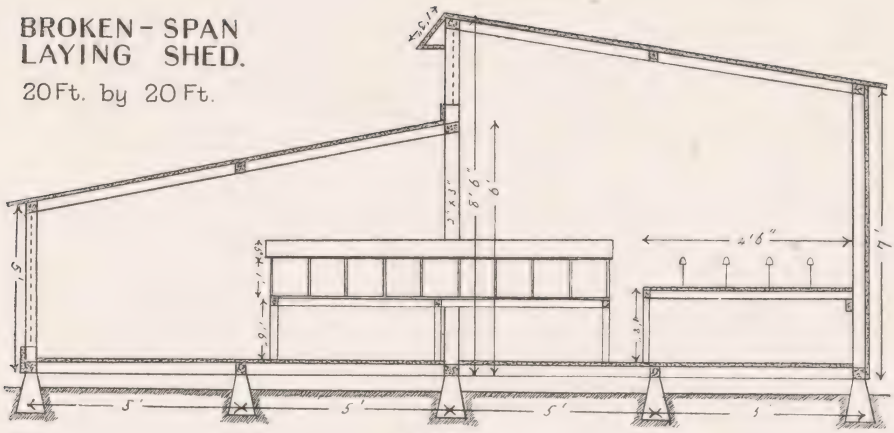

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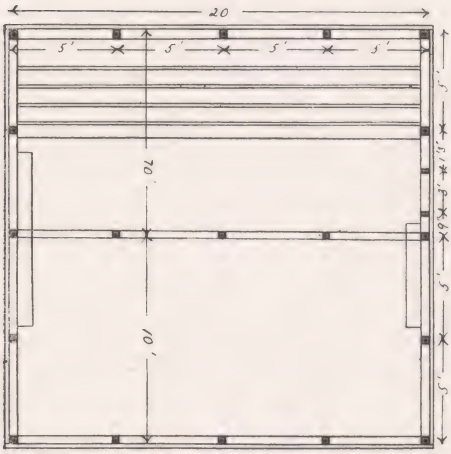
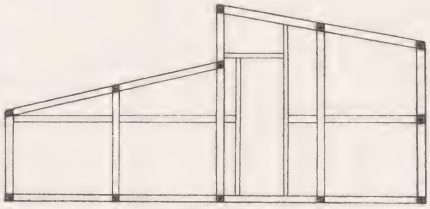
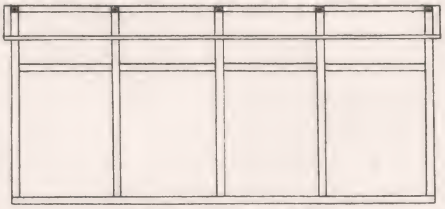


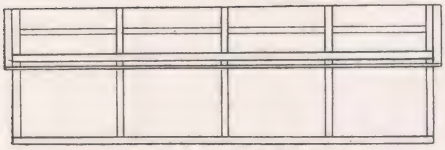
GROUND PLAN



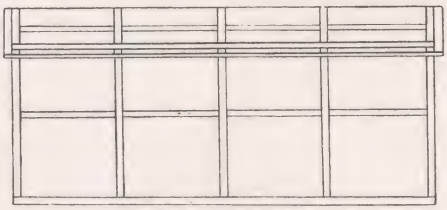
END FRAME



CENTRE FRAME



FRONT FRAME



BACK FRAME

to become fogged up with moss than those of the same quality of soil having a southern aspect. When the slope of the ground is at right angles to the rays of the sun—i.e., about 25 to 30 degrees—it receives the maximum amount of heat, but a slope of this angle would be rather steep for comfortable farming. . . . A gentle slope facing the sun is the most suitable, while a slope away from the sun is undesirable.' (1) For second choice south-east is preferable to south-west. An undulating country is much better than a plain. The latter is more exposed to prevailing winds, and seldom affords much natural shelter, whilst there is greater danger of the land being damp. Flat land is not easily drained, which may explain why under such conditions preference is shown for very light, sandy soil. It is desirable to secure the advantage of natural shelter in the shape of woods and trees, which protect against winds or extreme heat. Both of these are equally exhaustive. What should be sought for is protection against the winds which prevail in any district. In these directions portable houses for poultry enable the location to be changed in accordance with the season.

Nor should it be accepted that every place is equally suitable at all periods of the year. Varying seasons require change of methods. Low-lying lands are often excellent in summer when the weather is dry, and are preferable to higher, hotter soils at that period. On the other hand, the higher elevation, if not unduly exposed, is better in the colder months, due to the dryer conditions. Woodlands, by reason of being cooler and affording abundance of shelter, as well as providing an abundance of insect life, cannot be excelled during the heat of summer, but would be damp, dark, and cold for fowls in winter. Extremes should be avoided. Where the position is open protection must be given as far as possible. Where the soil is suitable fruit and other trees should be planted. When range is available northern slopes between the equator and the arctic circle should be used in summer, and southern during the colder periods. South of the equator the conditions are reversed.

General Principles.—Size and shape of poultry houses have their influence upon the well-being of inmates. Of greater importance is the application of hygienic conditions, so that the fowls or other inmates may have an opportunity, at least, of rewarding their owner for his enterprise. A vast amount of disease among domestic poultry is due

to neglect in this direction. During six months of the year fowls spend half, or more than half, the twenty-four hours on their perches in portable or colony houses, and where kept within enclosures probably three-fourths their time under cover. It is not, in our judgment, the type of house used, as whether it conforms to the requirements laid down. The experience of recent years has brought about changes which enable us to state clearly the conditions applicable to all such structures.

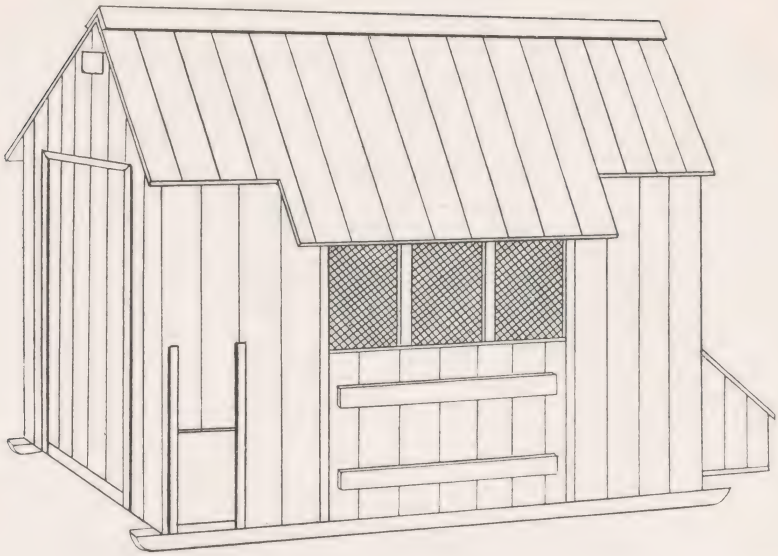
Materials.—Where poultry houses are permanent and not intended to be removed, there is no question that stone or brick, if these materials are easily obtained and inexpensive, are preferable, even though the first cost may be higher. Wood is generally used, for the reason that it is comparatively cheap, is easily handled, can be used for an erection that may require to be removed, and, where the land is rented, remains the tenant's property if built above ground. A large trade is done by firms in this direction. In many cases, however, to meet competition, the timber or lumber employed is unsubstantial or has not been properly seasoned. In the case of portable huts weight has to be considered. Consequently the same thickness of boards are not employed as in permanent or semi-permanent structures. Whenever possible the deals should be $\frac{7}{8}$ or 1 inch in thickness, of good quality, and be in dry condition. With buildings which are intended to be permanent, an excellent plan is to use overlapping boards, as these carry off the rain better than those which are tongued and grooved. With portable houses the latter are preferable. These should be vertically and tightly fitted, by which method there is less risk of water penetrating and making the interior walls damp. That, however, is often due to ineffective ventilation. Whatever the form of house, it is of great importance that the framework should be strong. In the case of larger portable huts, whether on wheels or runners, the under frame should be of 3-inch scantling, firmly bolted or mortised, as otherwise it would be unable to withstand the strain of removal.

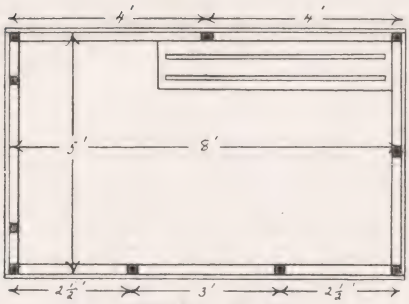
One of the most important considerations is to keep the interior dry. Another is to preserve the wood. To these ends the underframes should be well tarred, or treated with preservatives, and in the case of permanent wooden erections standing upon bricks or cement, a coating of tar should be spread over the top row or layer.

PLAN No. 3

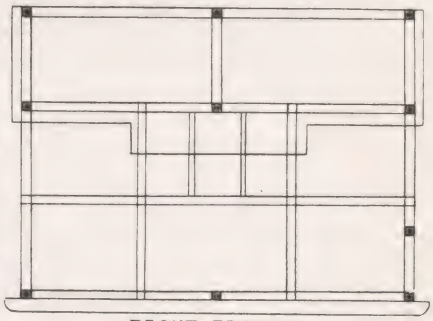
PORTABLE HOUSE

8 Ft. by 5 Ft.

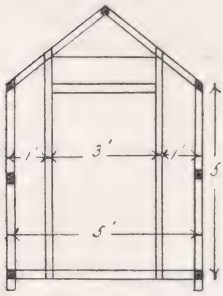




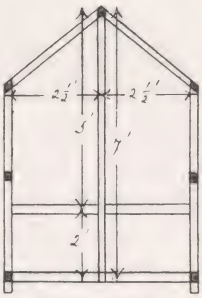
GROUND PLAN



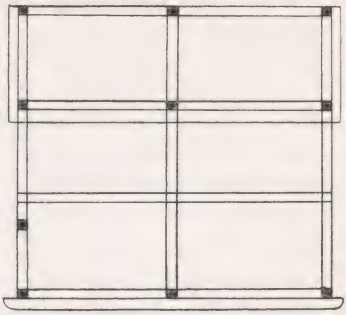
FRONT FRAMING



DOOR END



NEST END

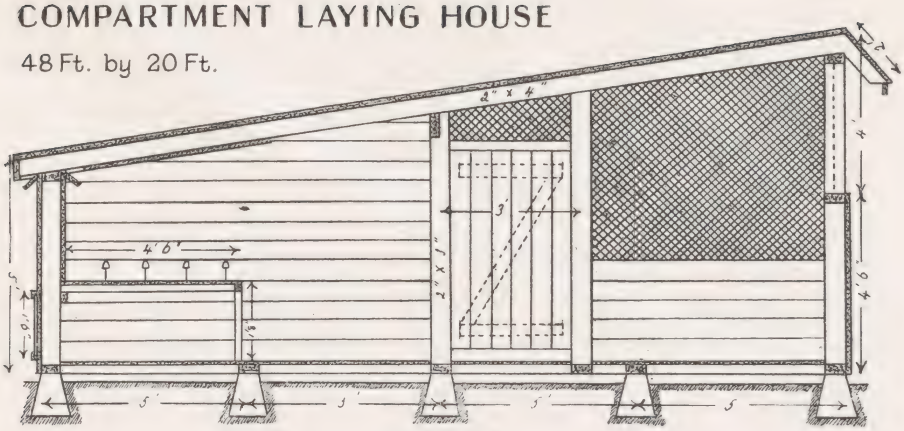


BACK FRAMING

PLAN No. 4

COMPARTMENT LAYING HOUSE

48 Ft. by 20 Ft.



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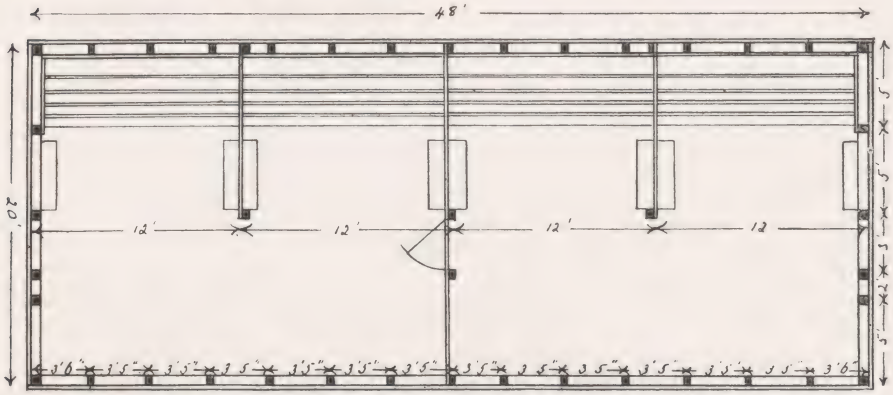
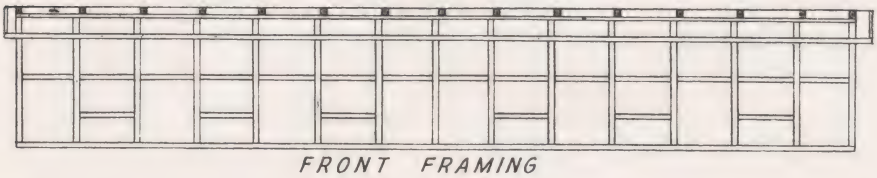
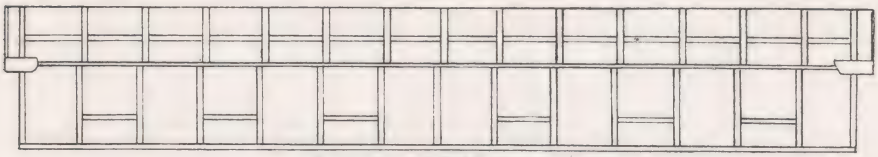


GROUND PLAN



FRONT FRAMING



BACK FRAMING

Painting a house improves its appearance, but is expensive to maintain. Gas tar does not look so well. It is, however, equally serviceable, and if mixed with a little petroleum, dries quickly. Creosote helps to keep down parasitic life. Other preparations are also available.

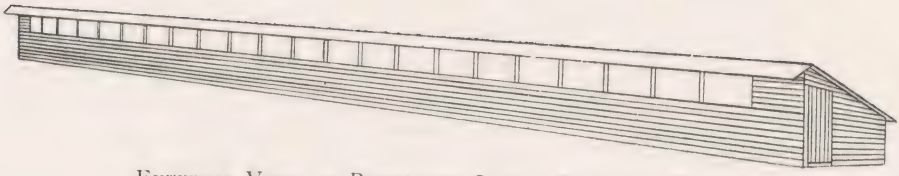
Roofing.—Heat and cold are atmospheric. A good roof is indispensable. The interior temperature is determined largely by it. A slight covering means that in winter the house will be cold, and in summer hot, due to radiation. A cold wind reduces the inside temperature by its action on the walls, yet not to the same extent as when the roof is inadequate. As a general rule the roof should be more substantial than the walls. That may be secured by thicker material, by doubling it, or by use of corrugated iron, felt, or any of the roofing materials advertised over wood. In countries where cold is intense in winter, straw chambers are found advantageous. In more temperate zones these are not required. Corrugated iron should never be employed alone, as it is a rapid conductor of heat and cold. When lined as stated above, it is excellent for carrying off rain, and by allowing air to pass between the corrugations, acts as a cushion against heat and cold alike. Ordinary commercial roofing felt is better fixed horizontally, with the edge of each upper strip projecting an inch above that below and be well nailed down. It should from time to time be well tarred which maintains it in good condition. Other forms of roofing materials may be treated as recommended by the makers. For permanent or fixed structures, it is well worth the additional cost to use felt between the final covering and the inner lining of match boards.

Ventilation.—The late Mr. W. E. Gladstone stated that oxygen obtained from the atmosphere is one of, if not the most important part of the food of animals. Upon this point Dr. Edward Smith, in his work on "Foods," says: 'The necessity for oxygen as a food is absolute and unintermittent. . . . The body is a great oxidizing apparatus, by which it sustains its bulk, produces heat, and modifies the composition of the atmosphere, and, when it has cast off that which, having been used, is no longer useful to it, not only deteriorates the atmosphere, but renders it impure. It is not too general an expression to say that every action within the body is accompanied by the consumption of oxygen and deterioration of the surrounding air.' In this direction considerable change of views have become evident

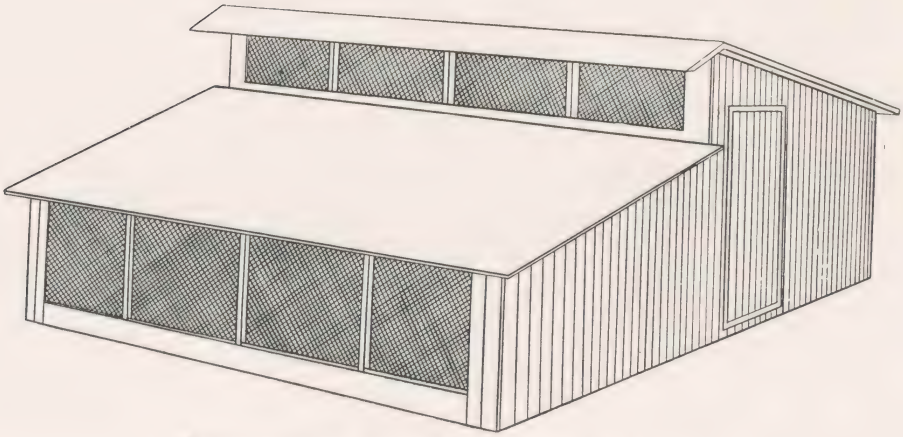
during recent years. So long as men and domesticated animals spent the greater part of the days in the open, and at night found accommodation in rough structures, the question was neglected. Probably the devasting plagues and epidemics which formerly swept away vast multitudes were due to dwellings where fresh air could find no access. Concentration and increase of numbers involve considerations which might not otherwise arise. The question of abundant fresh, sweet air is important for all animal life. It is specially so with poultry, from the fact that the body temperature is higher than that of mammals, and combustion is consequently more rapid. The body temperature is maintained by combustion of the nutritive food elements combined with oxygen, just as a fire cannot burn unless oxygen is mixed with the carbon of wood or coal. Insufficiency of oxygen results in reduction of consumption, loss of heat, and impregnation of the blood with impurities, thus causing disease. The old notion that conservation of heat was secured by " close, cabined and confined " dwellings, whether for humans or hens, is, it may be hoped, gone for ever. Body temperature is maintained by consumption of various elements to an adequate extent, not by prevention of that process.

Interesting observations respecting this question were made by Mr. E. J. Russell, D.Sc., and Mr. K. J. J. Mackenzie, some years ago which shows the necessity for effective ventilation of poultry houses. It was shown (1) that fowls breathe about a pint of air per minute, or 1.2 cubic feet per hour ; (2) with insufficient air-supply their respiration is impeded ; (3) the limit of impurity should not exceed 9 volumes of carbonic acid gas per 10,000 of air ; and (4) each bird requires at least 35 cubic feet of air per hour if this limit is not to be exceeded, and a freer supply was recommended. The British Factory and Workshops Act for cotton operatives allows the volume named in No. 3. For poultry it is desirable that the proportion of carbonic acid gas should be much less—nearer that of ordinary air, which averages 3 volumes per 10,000 feet in the country, and 4 volumes in towns. The final conclusions arrived at, so far as smaller poultry houses are concerned, were that 10 cubic feet of air space for each fowl should be the minimum, plus constant circulation of the air.

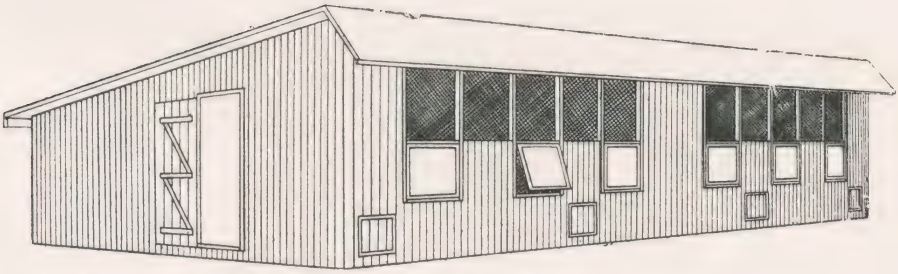
Methods of Ventilation.—The earlier attempts made to provide effectively for ventilation were by the use of small holes or louvre



Exterior View of Permanent Laying Shed (see Plan 1)



Exterior View Broken Span House (see Plan 2)

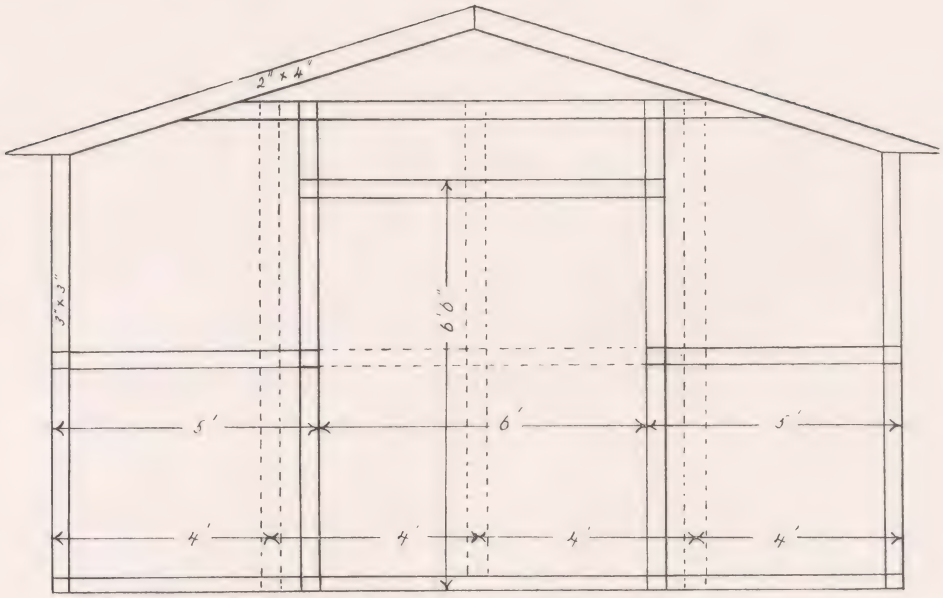


Exterior View of Compartment Laying House (see Plan 4)

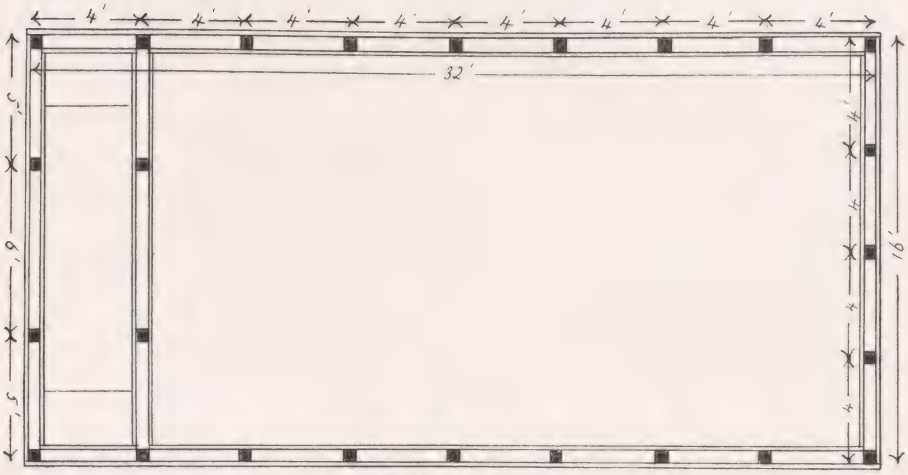
PLAN No. 6

INCUBATOR SHED.

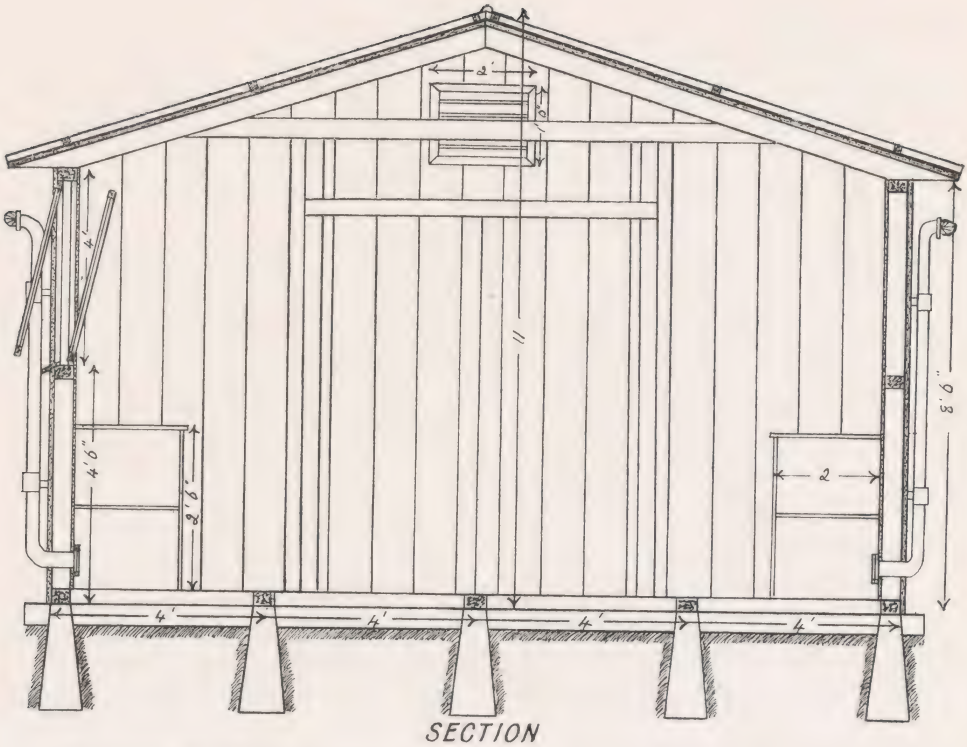
32 Ft. by 16 Ft.



END AND PARTITION FRAME



GROUND PLAN



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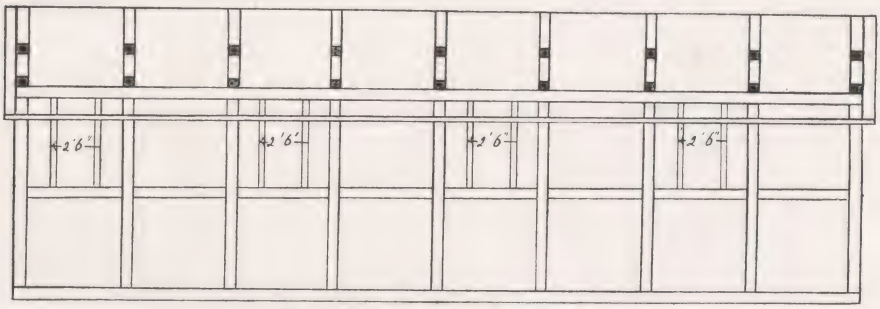
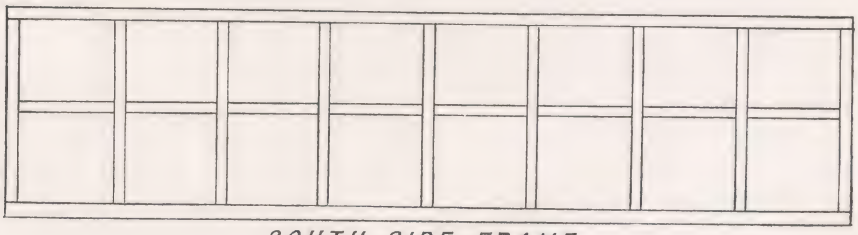


NORTH SIDE FRAME

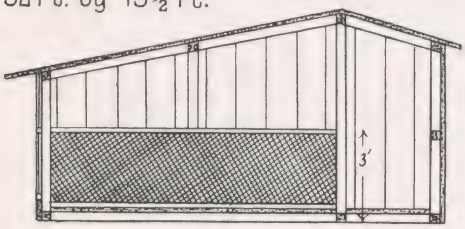


SOUTH SIDE FRAME

PLAN No. 7

BROODER HOUSE

32 Ft. by 13½ Ft.



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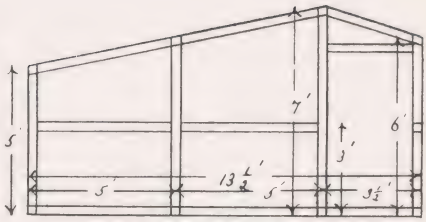

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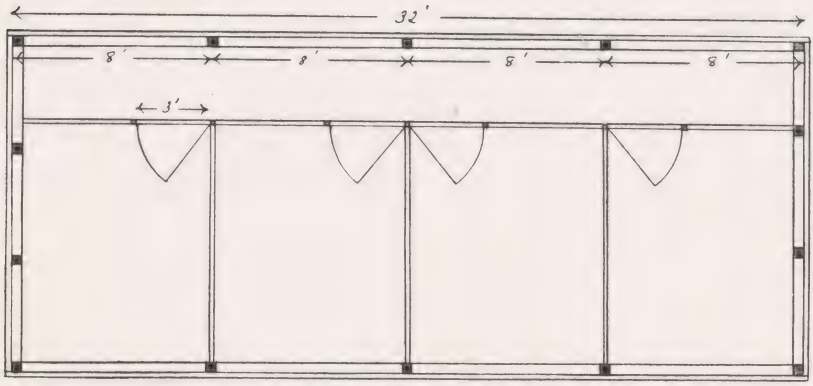
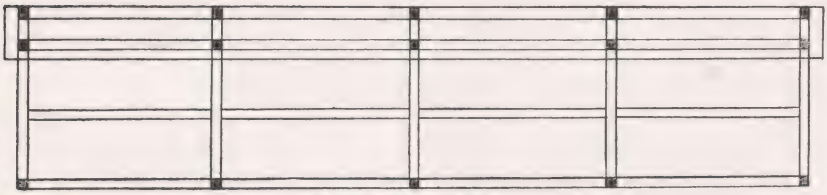


GROUND PLAN

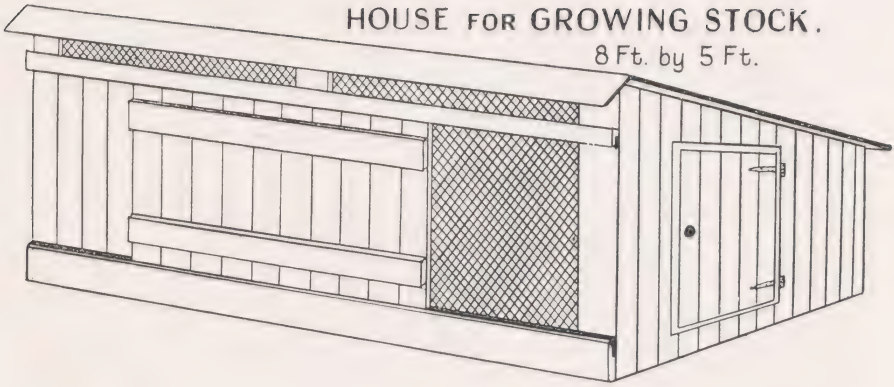
FRONT FRAMING

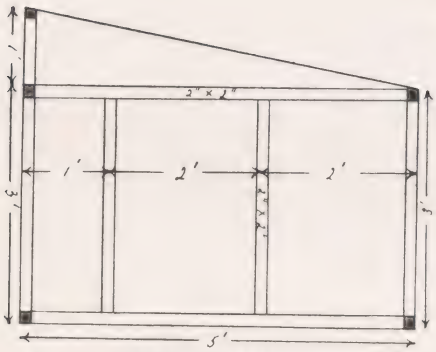


BACK FRAMING

HOUSE FOR GROWING STOCK.

8 Ft. by 5 Ft.





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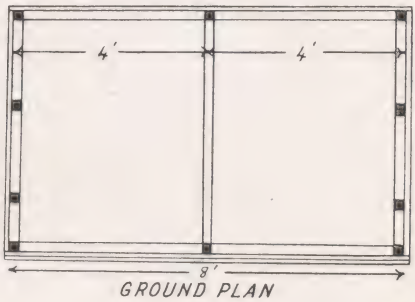
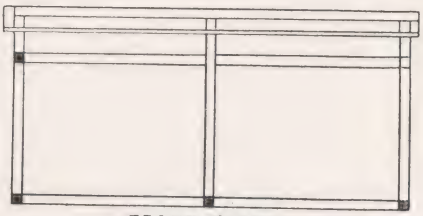


GROUND PLAN



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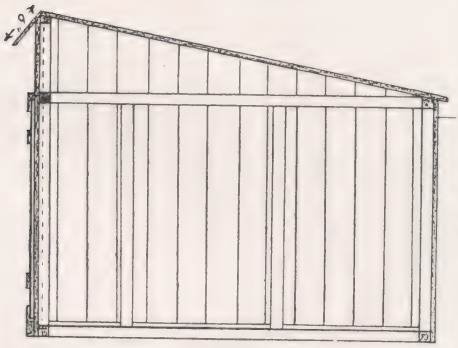

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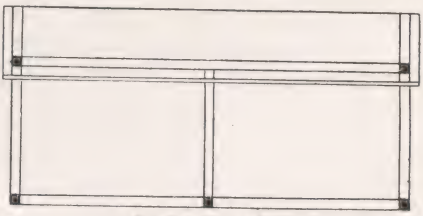
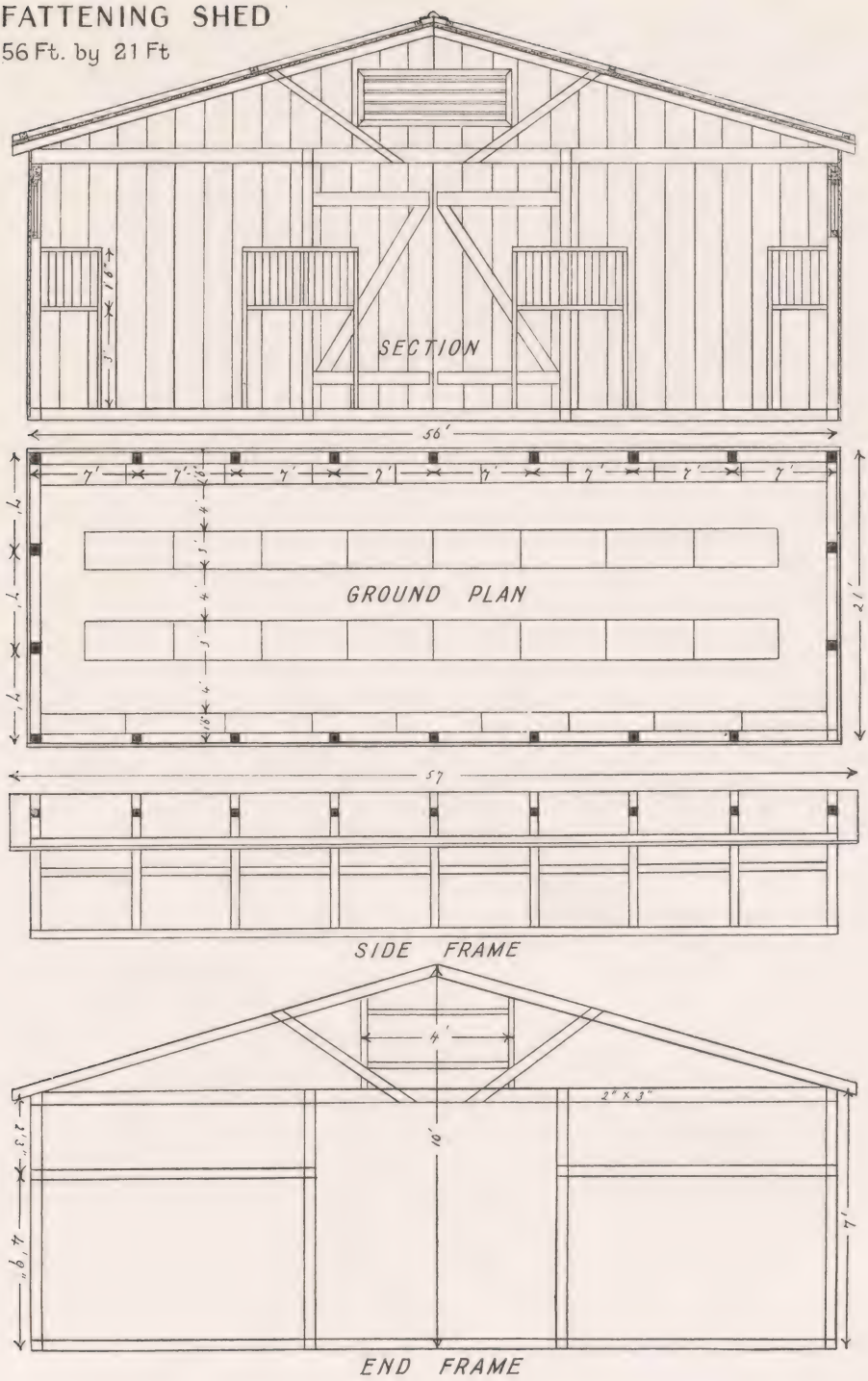


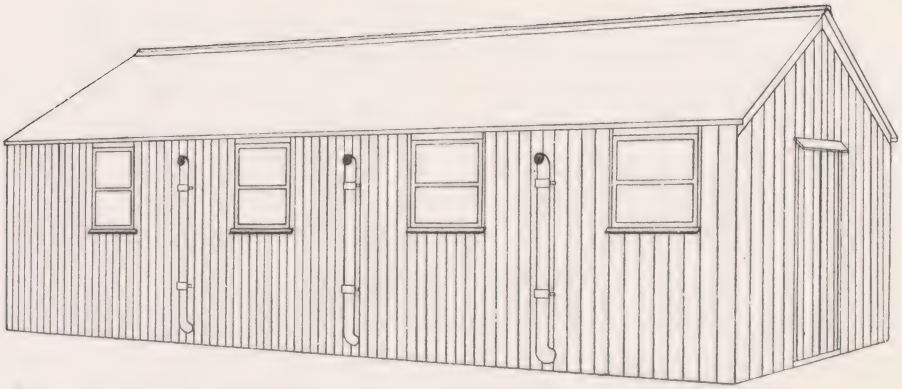
BACK FRAME

PLAN No. 9

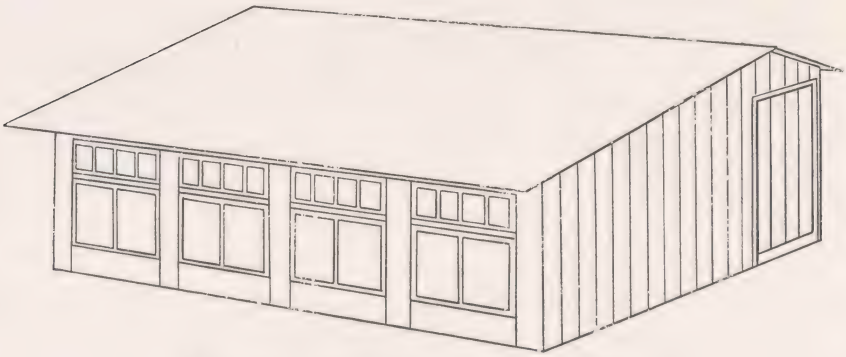
FATTENING SHED

56 Ft. by 21 Ft

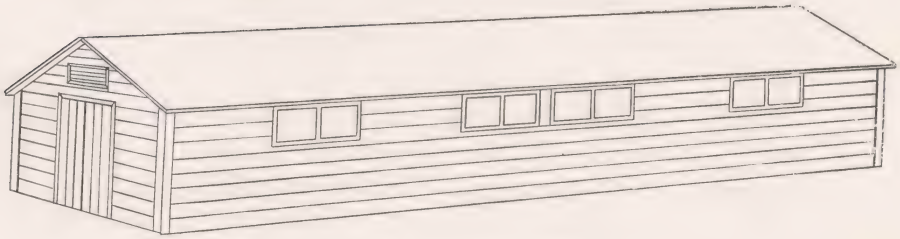




Exterior View of Incubator House showing Ventilation Pipes (Plan No. 6)



Exterior View Brooder House (Plan 7)



Exterior View Fattening Shed (Plan 9)

boards in the gables of the house, or by spaces beneath the eaves, or by air-shafts. Such arrangements were merely playing with the problem, especially where the number of inmates was large in relation to the cubic capacity. The birds underwent a slow poisoning, even where the air was pure at first. There was not sufficient circulation to insure constant carrying off the carbonic acid gas expelled from the lungs, or replacement by an adequate volume of fresh air. Introduction of the open-front house has altered the entire aspect of affairs. In this way the reserves of air outside can be drawn upon without any hindrance. There is a further consideration involved, namely, that ill-ventilated houses are generally damp owing to the condensation of moisture upon the interior walls, where there gathers water contained in the atmosphere, the humidity of which is increased by the expelled breath of the birds. A badly ventilated room, wherein are a number of persons, gathers moisture on the walls and windows. This moisture reduces the body temperature, and in cold weather the inmates are chilled. Many diseases arise in this manner. All houses ought to be open fronted, and in large buildings ventilation shafts should be placed at intervals in the roof. In colder countries curtains in front of the roosting places were used to afford some shelter or protection to the birds. That does not now seem to be required, and these are less used than was formerly the case. Under more favourable conditions they are not needed, and they do more harm than good.

Light.—As explained in Chapter XVII sunlight is the source of heat, and the sun's rays purify the atmosphere. Research has shown that bacteria and parasites multiply more rapidly within dwellings than in the open air. It is evident that, unless care is taken to prevent their increase, these become a very serious factor. The effect of the sun's rays, as already indicated, is to cleanse the air. During the warmer months of the year parasitic increase is very much greater in dark houses than in those which are well lighted, and into which the rays of the sun can penetrate. Introduction of the open-front house, if built in accordance with hygienic principles, and where glass does not destroy much of the beneficial influence, has effected a revolution in this direction. We have only to use our own observations in connection with human dwellings to note that, during the winter season especially, a dark room is very much colder than one which is well lighted. In

summer a poultry house facing south may be unduly hot. That can be met in other ways. During the winter the object of the poultry-keeper should be to secure the advantage of whatever sunshine there may be. At all seasons of the year the interior of poultry houses should be lighted so that the rays of the sun are able to reach all parts of the floor space. That is specially important in scratching-sheds for the reason that so much of the daylight is spent by the birds under cover.

From the fact that where open fronts are used in poultry houses, that is, these are wire netted, during very severe weather the temperature of the interior is reduced to a considerable extent, and that rain and snow can sweep through the netting, glass has been largely employed to give the needed shelter without preventing the admission of light. That undoubtedly accomplished the purpose. Recent discoveries, however, have shown, as has often proved to be the case, that there are influences at work which had not been realised. The conclusions arrived at are that what are called ultra-violet rays are, both for adults and growing stock, of the utmost importance for health, productiveness and prevention of disease, as indicated in Chapter II. Further, that ordinary glass does not transmit these rays, so that the birds are deprived of a necessary and beneficient influence. This is a question of the utmost importance. In the more temperate regions, even during winter, it is better to have no glass whatever over any part of the wire netting, securing shelter in other ways. In colder climates the special glass which is now on the market, and which it is claimed passes the ultra-violet rays, should be installed. It is as yet too early to assume that the statements which are made have been fully justified.

Heating.—Formerly a very common idea was that the warmer conditions which prevail during the spring and summer are responsible for increased egg-production at those seasons of the year, and that at other periods the application of heat artificially provided would have the same effect. Experience in many countries where tested indicated that whilst more eggs would thus be obtained, these were at the expense of health and vigour, and that the general condition of the birds and their progeny suffered seriously. Further, it has been found that the fecundity of hens is largely determined by two factors, namely, the length of day when they are able to work for and consume food, and

capacity, which may be developed by selective breeding, plus favourable environment. As indicated in Chapter XXVIII lengthening of the working day by artificial lighting has brought about a remarkable change in winter production. Artificial heating is undesirable and does much harm, causing debility of constitution and reduction of vitality.

Floors.—The floor within a house for poultry should be determined by the type of building, that is, whether it is permanent, temporary, or portable. In large semi-intensive houses, as these are not to be moved, cement forms the best floor, if thickly covered with litter, otherwise it is cold and hard to the feet of the fowls. One great advantage is that rats find a difficulty in working their way through, and especially if wire netting is laid down as the foundation. By presenting a smooth, solid upper surface, without interstices in which manure can find a lodgment, that can be cleared away more easily. The one supreme objection to bricks, which are warmer than cement, is that they are absorbent and there is danger of the excrement gathering between the rows. Cement is generally the cheaper, but must be well laid on a firm foundation otherwise cracks will appear. There should be a border of bricks of, say, three or four courses, on which the walls will rest, within which a bed is made and cement laid over all. An excellent plan is to cover the wire netting referred to with gravel or broken stones, laying the cement above the latter level with the brick border. Where gravel is very plentiful, the floor may be entirely of that material, rolling or beating down each layer as placed, using coarser below and finer on top. With the last named may be mixed lime or cement, and the whole rolled until it presents a smooth appearance.

For medium-sized houses that may be removed after the lapse of time, supporting walls should be erected as indicated above These raise the floor above the level of the outside ground and thus prevent dampness. In that case gravel should be used if available. Sand is not suitable if litter is to be used, as it does not form a hard bed. Preferable to that is well-beaten earth. Where the materials referred to are unobtainable or too expensive wood is often the only flooring that can be employed. In that case there should be a thick covering of litter. Wood is very absorbent, and if not so covered becomes charged with ammonia, though this can be prevented to some extent by tarring once a year and by rigid cleanliness.

Intensive houses unless these are moved frequently usually are floored with wood. In either case sand should be placed above, dug over constantly and renewed frequently.

Portable houses, whether on wheels or runners, are employed for roosting and laying quarters. Scratching-sheds would add considerably to the weight without any commensurate advantage. Birds on range can find abundant opportunities for scratching outside, and usually shelter. The most desirable arrangement is to make the ground upon which the house is placed its floor. By so doing the work is simplified. The manure as voided falls directly upon, and is absorbed by the soil, so that its full value can be realised. Houses are usually warmer in the colder periods of the year, unless allowed to become damp, with an earthen than a fitted floor. There are, however, difficulties arising from the fact that unless the walls rest upon the earth draughts sweep inside and may chill the inmates. Attempts have been made to obviate these by hinged or sliding boards, or by raising and lowering the structure. Such have not proved satisfactory. As a consequence it is generally found that wooden floors are fitted to all forms of portable or colony houses.

Perches.—Fowls and turkeys roost, ducks and geese do not. Under natural conditions fowls roost in the trees, generally as high up as they can get. For that reason, when the birds are placed under cover, it has been thought that perches should be high, hence the old ladder form, one end of each supporting upright resting upon the ground, and the other against the wall. More birds can be accommodated on this than any other form of perch. It is not to be recommended, though in a large open shed the fowls obtain an abundance of fresh air, which is not the case in smaller erections. The better plan is to have all perches on the same level and not more than 2 feet above the ground. The nearer the birds roost to the earth, the cooler in summer and the warmer in winter.

Perches may be made either of fir or other poles, not more than 2 inches in diameter, or pieces of quartering 2 inches by 1½ inches, with the corners rounded off on the upper side. In houses of moderate capacity, say, five feet in width, sockets can be fixed on the walls, in which the perches rest, so that they can be easily removed. In larger houses a frame can be built by which they are supported in the same manner.

All perches should be removable. An excellent plan in large houses is to fit the perches on to a rigid frame, hinged to the back wall, so that during the day time the whole can be raised, thus giving a greater range of floor. Sliding hinges should be used so that all can be removed.

Unless the perches can be placed in the centre of the house, which for various reasons is not generally adopted, there should not be more than two, one behind the other, and about two feet apart. It is a question of atmosphere. A well known fact is that where there is a dense mass of breathing creatures, whilst those on the outside are able to obtain an adequate supply of fresh air, such is not possible to such as are in the centre. Considering that these are breathing a fetid atmosphere for several hours of each day, they are all the time being deprived of a most important element and suffer from the slow poisoning by carbonic acid gas.

Nests.—Fixed nests should never be used, owing to the difficulty of keeping them clean and free from parasites which thus find a harbourage. For small flocks single nest boxes without bottoms are commended. Where numbers are greater, allowing one nest box for each three hens, an excellent arrangement is to build these in one or two rows of four or more, the lower tier on a shelf raised a foot above the ground, and the flat top of this tier forming the bottom of the upper row. In either case the higher row should have a sharply sloping cover, to prevent the birds perching on top. As each row is lifted the contents drop out. By limewashing the boxes regularly, and replacing the nesting material, straw, hay, or chaff, all risks of parasites should be avoided. In very large houses an excellent plan is to have a separate laying closet or compartment, where the hens can be undisturbed. Nests are always better where there is not too much light. In some forms of portable houses a row of nests is fixed on the outside with sloping lid, with access for the fowls from the interior. In that case the bottom of the boxes should be hinged to facilitate cleaning.

Trap nests are described in Chapter XXVIII.

Draining.—One point of considerable importance is that the natural drainage should be from, and not to, the building, in order that the floor and surrounding ground shall be dry. As a question of shelter and protection, a hollow would be a desirable location. In wet weather, however, drainage is towards the centre of the depression,

resulting in sloppy soil outside, and dampness inside, the house. Where the position is on a natural slope water may run under or below, unless this is prevented, by raising it up above the level, or cutting a water course around. The greatest danger is on low-lying valley lands. In erecting a large or fixed house for poultry, a wise precaution is to place under ground a series of drain pipes leading from the building. Gutters should also be fitted to the roofs, with connecting pipes well down into the earth, unless water tanks are used. Small huts may have gutters projecting over the ends, or the roof extended to prevent water falling on the walls.

Farm Buildings.—In nearly all countries the fowls kept upon farms have been housed in one of the buildings or sheds. Where the number of birds was small, and no special provision was made, allowing them to select their own quarters, they usually chose an open shed. The usual rule was to accord the birds some unused shed, usually small, dark, ill-ventilated, and frequently dirty. The danger line is passed when the numbers are increased beyond the capacity available for their accommodation. Formerly such was the general practice. In that respect a considerable change has taken place, at any rate in progressive countries. Whatever the form of roosting quarters for poultry these should conform to the principles here set forth.

Size of Houses.—The question of amount of space to be allocated for each fowl has been referred to under the head of Ventilation. We have now to consider the actual size, with which is involved the number of inmates. As already stated there is always a tendency, in spite of many failures, in the direction of massing great numbers in one building. It may be true that the capital expenditure is thus reduced, and also the labour. Production under these conditions is comparatively low, which more than counterbalances these savings. At times big buildings are made square, or nearly so, and as a result the inmates when at roost are concentrated, sometimes in groups of hundreds together. The modern type which has proved most serviceable for commercial Poultry Husbandry is long and comparatively narrow, often termed long-range houses. Were it not for the question of outside runs, these types when properly constructed, and the perches are ranged along the back, would have become almost universal from the fact that overcrowding is obviated.

EXTERIOR AND INTERIOR VIEW OF LAYING HOUSES, 125ft. x 21ft., holding 750 birds
(Messrs. John H. Dowden & Son, Heydown, Heathfield, Sussex, England)

In respect to size of poultry houses, experience has shown that there are increased risks of disease when birds are massed in large numbers. Should any inmate become infected, those exposed to its influence are more numerous than when divided into smaller flocks. As a rule epidemics are seldom discerned at the early stage. Moreover big flocks appear to be more susceptible under these conditions, possibly owing to increase of parasites and bacteria.

There is also the question of productivity. Observations at home and abroad have shown that the fecundity of hens massed in large numbers is distinctly lower than when divided into smaller flocks. This result may arise from the fact that more careful selection is made and these are individualised to a greater extent, when in small numbers. In spite of many efforts to overcome what is here stated the fact remains that such is the case, and that it is fundamental. Investigations have shown the importance of air, or, rather, the oxygen in the atmosphere, to every form of animal life, which appears to afford an explanation why birds massed in large numbers are less productive than if divided into moderate-sized flocks. To some extent the long, narrow houses solve the problem, though not entirely so. The reasons for decreased fecundity are given above under perches.

Shape of Poultry Houses.*—The minimum cubic capacity per inmate has already been stated. It is found, however, that with an increase in the number of inmates there should be an advance *pro rata* of the cubic space. Ten cubic feet per unit may be regarded as the minimum in smaller buildings which have no scratching-shed. As the size of building and number of inmates are increased, the capacity must be enlarged, both by extended floor space and elevation of the roof. The latter is essential to effective circulation of the air. A five foot gable is enough for a dozen birds, a six foot for twenty-five, whereas for 150, 8 to 9 feet is requisite. In scratching-sheds 4 square feet of floor space should be allowed, with a shed roof rising to 8 feet. In a building 30 feet long by 20 feet deep for 150 birds, the front elevation may be 9 feet, and give a cubic capacity of more than 30 feet per inmate.

As a general principle, an oblong shape is preferable to any other, the greater length forming back and front, and the shorter forming ends. In this manner a maximum amount of light and ventilation

*Plate LXXVII.

can be secured. Very long buildings should be divided by partitions into compartments, each 10 to 20 feet wide in accordance with the depth. For smaller groups such as breeding pens a house 10 feet square can be commended. A deep house with a narrow front is undesirable however well it may be designed. What requires to be emphasised is that as the depth of house from back to front is increased so must be the front elevation, in order to light the entire floor space. A house 10 feet in depth should have a front 6 ft. 6 in. high, one 20 feet, 8 to 9 feet.

For portable houses to stand in the open fields, the best type are those with gabled roofs, as these are less liable to be overturned by winds. In larger structures of a more permanent form, the sloping or shed roof is preferable, the front (in northern hemispheres) facing south, or as near that position as possible. Such erections, however, offer a greater resistance to the wind, and in this way the inside temperature may be influenced. Consequently, in selection of position, it is important to take advantage of whatever shelter is available. Some excellent forms of poultry houses are built with a double pitched roof, uneven on the two sides, in which case the frontal slope should be the shorter, and not carried as low as at the back. A low fronted roof is unsatisfactory.

Portable Poultry Houses.*—The form most suitable to general farms, or where the birds are on free range, is that which can be moved about from place to place, fitting a rotation of crops, not destroying the growth of grass, and distributing the manure. Food which would otherwise be wasted is eagerly consumed by the birds, which can thus be fed cheaply, and the advantage of giving them fresh ground to roam over is very manifest. On fields under hay the fowls need not be moved until eight weeks prior to cutting, which avoids all danger of the grass becoming trodden, the crop coming strong and in good condition. On arable land these can be placed out before the plant appears, when it is well up, and after harvest. Fowls do not interefere with dairy cattle, or cattle with the fowls. Where grain and roots are sown, the houses can be placed in the corners of the fields. Though for a yard or two around the ground is bared, that is all the damage which results. The birds wander in and out among the grain and roots without injuring them, rendering service by keeping down parasites.

*Plan No. 3.

Where the houses are not intended to be moved more than once or twice a year those up to 10 feet square may be used, building them in sections which, bolted together, can rapidly be taken down and re-erected. Such house may be used without a floor if the earth is covered with dry soil or sand, and renewed as may be thought desirable. This form is specially useful on arable land. On grass a 6 ft. by 8 ft. house is an excellent size. It should be fitted with wheels or runners to facilitate removal. As a rule this type of house is fitted with a substantial wooden floor, which is sprinkled with earth or sand, and cleaned out frequently. Attempts have been made to dispense with floors by an arrangement so that the house can be raised up for removal, and lowered on the new location. In practice this method has not proved satisfactory.

Many portable houses are insufficiently ventilated and are dark when the door is closed. As they are used for sleeping quarters the inmates occupy them for the shorter part of the day. Hence a scratching-shed is not required, nor is it necessary to flood the entire floor with light. The upper half of one side should be formed of wire netting, thus giving free access to air. Over this a shutter may be fixed, hinged at the top, to carry off the rain in unfavourable weather. At all other seasons it should be left open.

For the Colony system as previously described the somewhat larger type of portable house is preferable. Where there is a considerable number of these an excellent plan is to have a bogey fitted with broad wheels, or a sleigh, on to which each of the houses in turn can be lifted. Such must be wide and strong. It is also possible to attach removable wheels to fixed axles.

Scratching-Sheds.*—Introduction of this system has revolutionised Poultry Husbandry, and made the commercial methods possible. Modern developments are built upon it. The objects in view are two-fold: First, that the birds may have shelter during unfavourable weather, and, whenever necessary, be kept entirely under cover, affording them sufficient space for health and comfort; and, second, that they may be induced to take abundant exercise, by supplying grain in litter, thus compelling exercise by working to obtain it. The latter of these is of special importance. Fowls at liberty, that is, on range, do not require any stimulus to exercise. If not overfed, all day

*Plans No. 1, 2, 4, and 5.

long they will be searching for food, thus keeping their organs and muscles active and healthy. When kept under restricted conditions, owing to lack of and to obtaining food without exercise, the tendency is to a lethargic habit of body. As a consequence fatty deposits accumulate on the muscles and organs, tending to reduction of productivity, to liver and other digestive troubles.

Whilst agreeing in essential details scratching-sheds are of many different forms. The main principle is the same, namely, that these are of sufficient size to enable the birds to move freely about under cover, to constantly scratch for grain, under conditions which give them abundance of light and of fresh air. As a result they remain in the shed either when so engaged or roosting the major part of the day. Thus contamination of the ground outside is reduced to a minimum from the fact that the bulk of the manure voided by them falls inside the shed. In those countries where winters are long and severe it is often necessary to enclose fowls within the house entirely for a longer or shorter period, often many weeks together. That is not required under more temperate conditions, and should be avoided as far as possible.

In building these houses, no matter what the size may be, it is important that they be well built, have open, that is, wire netted fronts so that there is abundance of light and air, that the perches be placed at the back, under which may be dropping boards to catch the droppings when the birds are at roost, or manure pits, and that they be partitioned into compartments. The former system adds to the floor space, but otherwise offers no advantage. It is important that in larger houses, say, 16 to 20 ft. in depth, there be ventilation under the rear eaves over the heads of the birds, as otherwise there would be insufficient circulation. It has been found where this system is not applied the inmates have a marked tendency to roup, apparently due to breathing of impure air. The deeper a building from back to front, the greater is the need for back ventilation, which, however, must be so provided that the inmates will not be subjected to draughts.

There are many and varied opinions as to the depth of scratching-sheds, that is, the distance from back to front. In our judgment this may extend to twenty feet provided that the length is commensurate, and, to permit free circulation of air, the length of house or com-

PLATE LXXVIII

Above: Range of Breeding Pens; *below:* Exhibition Penning Room
(Lord Dewar, The Homestall Poultry Farm, East Grinstead, Sussex, England)

partment should be fifty per cent greater than the depth; that the height of the roof and the front elevation correspondingly be increased with the depth, so that the entire floor space is well lighted and flooded with sunshine under ordinary conditions. To that end, for reasons stated in Chapter XVII, the front should consist of wire netting. During the less favourable seasons of the year this may be partially covered with the special glass, such as Vita, which, it is claimed, does not intercept the ultra-violet rays of the sunlight. At other periods it is wise not to use any glass leaving the netting uncovered. In some of the colder countries muslin curtains have been suspended in front of the perches to maintain a moderate warmth. That, however, is of doubtful advantage. These sheds are fitted with perches and nests in accordance with the number of inmates, the latter of which are preferably placed where the inmates will be undisturbed.*

Reference has already been made to the important part which oxygen plays in the animal frame. That element is essential to health. Experience has shown that oxygen, plus vigour of constitution, are indispensable to secure productiveness. With a well built house as here described, one that is effectively ventilated, it will be found that when the birds are roosting they are quite comfortable, even in winter, as there is no condensation on the walls of vapour. That is the cause of chills and other diseases. It is damp which causes trouble, combined with low temperature, resulting in frosted combs. During very hot weather and intense sunshine an excellent plan is to have green holland curtain a foot or more behind the wire netting, as that helps to keep the air cool.

Litter.—In scratching-sheds an essential factor is that a considerable portion of the floor space, all except that under the perches, should be thickly littered with straw cut into moderate lengths, or chaff, or other friable material which will not bind or bed hard. The deeper this is the better. Of what it consists is largely a question of cost. In this the grain fed is scattered. To find it the birds have to search and scratch. Every time they use their claws to uncover one grain, they help cover up the rest. In doing so they obtain a considerable amount of exercise. That is, in brief, the value of the system, namely, by working for their food and keeping their muscles and organs in good order. Without exercise of every part of the body there can-

*Plate LXXVIII.

not be effective digestion of the food. In districts where sand is plentiful that material may be used, in which case it is necessary to bury the grain more deeply. That there are risks by using litter is unquestionable, chiefly by manurial contamination of the grain. By using a thick bed, and renewing at stated intervals, in accordance with the number of birds, these can be avoided. The gain is much greater than any possible loss. Semi-intensive poultry husbandry would ultimately fail unless the stamina of the hens can be maintained, which will not be unless there is abundant exercise of muscles, limbs and organs.

Range or Single Houses.*—Observations in many parts of Europe and America have shown that in almost every country there is a strong tendency upon commercial farms to the use of long range houses for poultry. In some instances such houses have been erected 200 feet long, divided into compartments. There is no doubt but that these are very imposing, are economical of equipment charges and of labour. What might be termed factory methods have a great attraction, forgetful of the fact that poultry are living entities and not inert material, also that atmosphere and soil are contributory to their well-being, as is plant growth. Difficulties which arise are not due to the houses, except under the highly intensive systems where the birds are kept under cover all the time, but to the fact that in many cases the amount of land over which they are able to or do roam is totally inadequate, and that sooner or later, in spite of partial cultivation, the soil becomes impregnated with manure. From the fact that these buildings are fixtures there is no means of giving fresh range. Where these are entirely used for layers and not for breeding stock, during the winter months enclosing almost entirely under cover and replacing the stock when two years old, the system may be made profitable, most of all if free range can be given in the spring and summer. In that way there may be prevented all danger of soil contamination. It is the attempt to combine laying, breeding, and partial though limited range which has broken down. Many of the "has beens" in Poultry Husbandry have proved what is here stated by costly experience.

Not a few of the houses of this class which have been visited display considerable ingenuity on the part of the owners, and were well designed to save labour. In others it appeared to be evident there was an idea that elaboration was the road to success, than which

*Plans 2 and 5.

Top: Free Range House for 100 Pullets, 24ft. x 12ft.
Centre: General Type of Lancashire Cabin, 12ft. x 8ft.
Bottom: Standard Breeding Penhouse, 13ft. x 9ft.
(By courtesy of Mr. J. Wrennall, Barton, Preston, England)

can be no greater mistake, both by reason of the expense, first or subsequently, and that the inmates prefer simplicity plus suitability of conditions. Such erections may have an advertising value. Practically they are a mistake. From the fact that these long range houses are less in evidence than was at one time the case it may be assumed they have not proved themselves as a desirable form.

A more desirable method is that adopted by Mr. T. W. Toovey, of King's Langley, Herts, England, who has been one of the most enterprising poultry farmers, and entirely for market production. He is ready at all times to test new methods, and does not hesitate to scrap his plant if it does not meet his anticipations. His poultry farm consists of about thirty acres. At one time this was occupied by small houses and pens, which have been scrapped. A series of large 30 foot by 20 foot houses, divided into two, have been erected. These houses are well built, are lofty and ventilated in accordance with the principles already laid down. The fronts consist of (1) near the ground two feet boarding, above which (2) is glass to the same depth, and (3) above wire netting to the roof, which is sled or sloping from front to back. The netting is never covered, but attached to the roof is fixed board to carry off any driving rain. Inside the houses are fitted in the usual way. They have well laid cement floors. The land is divided into runs of four acres each of which is subdivided. Four houses are allocated to each four-acre section and evenly distributed. The two parts of each section are used in alternation, and when vacated are cultivated. As each house accommodates 150 hens, there are 600 birds at a time on every two acres, or equal to 150 birds per acre of the entire section. As a rule they spend most of the time indoors. The fact that this farm has now been run for nearly twenty years on the same land is indicative of its success.

Small Poultry Houses.*—There are great opportunities for the keeping of poultry, more especially fowls, in gardens and small town lots, where steps must be taken to afford an adequate amount of protection and shelter. Under these conditions, usually non-economical in that the cost is not a primary consideration, the equipment can be varied in accordance with the taste, desires, and pocket of the owner. Sometimes very elaborate and ornate houses and runs are provided for the birds, by reason of the fact that the owner wishes for a plant

*Plate LXXIX.

in keeping with the surroundings. To this there can be no objection, so long as essential principles are observed. To sacrifice the health and comfort of the inmates for the sake of appearance is courting disaster. Some of the most successful small poultry keepers we have known used the most primitive structures. Sugar casks, piano cases, and large boxes, can be turned into useful huts for poultry by the application of time and ingenuity, and at very little cost. The form of the house can be varied according to taste of the owner. It must, however, conform to the requirements for maintenance of health enumerated above. Where there is an enclosed run attached but no shelter shed, then there should be 4 square feet of floor space in the house. If separate shelter can be given 2 square feet of floor space is adequate. Better, however, give more than that stated than less. A very excellent arrangement is, in the case of one of the ordinary forms of small houses, to extend the roof 6 to 8 feet beyond one wall, as in this way protection is given separate from the roosting place, and the birds can be kept enclosed altogether, which is sometimes necessary. Under such conditions the run should be laid down in gravel, which can be swept regularly so as to remove a large part of the manure, or in sand, to be dug over occasionally, or in fine ashes. The two last named should be renewed every two or three months, and more frequently where the accommodation is small for the number of occupants.

Shelter Sheds.—Unless the area is bare and exposed poultry on range do not require any special provision in the direction of shelter. Trees, shrubs and hedges afford all that is necessary. As a rule such birds are inured to meet the conditions, largely due to the exercise obtained. Warmth of body is maintained by a more rapid circulation of the blood. Under a restricted environment where they cannot find shelter, and from the fact that they are less physically resistant, some special provision is desirable. That is why scratching-sheds have won great favour. Where smaller houses are used an excellent arrangement is to provide adjacent to, or near by the roosting quarters a roomy shed of simple construction consisting of roof and two or three sides, which are built facing whence come prevailing winds or rain. Clumps of trees or bushes may also be planted. Shelters may be improvised by hurdles interlaced with furze or branches of trees. Another useful form is of wood with four solid partitions set transversely, the fronts

being open so that the birds can use whatever section they desire. A useful size is that each partition is built 3 feet high and 6 feet long. A roof will keep off rain and snow. Otherwise it is not necessary.

Fences and Yards.—Where poultry must necessarily be kept under restricted conditions it is essential that the flocks be separated by fences. That adds considerably to the costs of equipment. For this purpose wire netting is the best material. It is, however, expensive owing to its comparatively short life. Netting of good quality will, however, last several years. It is made in rolls of 50 yards, and of varying width. Where chickens are to be enclosed, the mesh should not be larger than 1 inch. For adult fowls an ordinary 2 inch mesh is used, and offers the maximum of strength with the minimum of cost. The smaller the mesh the greater the amount of wire used, and the higher the price. The height of fencing must be determined by the class of poultry to be enclosed. Heavy-bodied birds can be restrained by a 3 or 4 foot fence, whereas light, active breeds, can, if they wish, surmount 7 or 8 feet without difficulty. Provided there is a good-sized run and the inmates are well employed, a fence 6 feet high is ample for practical purposes even with the lighter-bodied fowls, if netting is fixed of that width, and the supporting posts are carried one foot higher, with a single strand of wire stretched on top of the posts. This prevents the birds flying over.

For fixed runs, posts or fir poles 3 by 2 inches in diameter, should be driven into the ground, upon which the netting is fastened by staples. For a 6 foot fence the posts should be at least 8 feet long and pointed at one end. Much depends upon the nature of the soil. Where it is very light a greater length will be required. These will last much longer if well tarred or creosoted before they are driven home. Prior to erecting the fence, gates should be planned and fixed. These facilitate the labour of management. Extra gates leading from one run to another, and to the outside fields, will save a considerable amount of time. Where runs are arranged side by side, unless these are divided by solid partitions, which is a needless expense, and most of all where the runs are small, male birds will quarrel and often injure each other. For this reason the bottom couple of feet of fence may be closely boarded, or sheets of corrugated iron fixed against the posts. Such affords shelter against strong winds. That is not necessary

where the inmates in adjoining runs are all hens. Under such arrangement the netting need not be continued to the ground, but to the top of the boards or sheets. In that case narrower netting may be used. Care must be taken to leave no gaps.

Wire netting is greatly improved in appearance when it is stretched tightly. To do this is by no means easy. Hence the ragged, untidy fences which are often seen, as it is an awkward material to handle. At intervals strong stays should be fixed to the posts, otherwise these will yield as the netting is drawn tight. An excellent plan is to run strands of wire along the tops and ground levels of the posts. When the netting has been drawn taut and fixed by staples to the posts, it should be tied first to the upper strand, then drawn towards the bottom strand and tied, or to the boards or corrugated iron if these are used. With these latter the posts may be 10 to 12 feet apart. If only netting is used the intervals should be 6 to 8 feet.

Posts for gates require to be strong and firmly fixed, with stout stays carried at a right angle well into the ground to keep the uprights firm. Also, the posts may be carried a foot higher than the netting, and have a transverse length of wood firmly fitted thus making a frame. The uprights should be 4 inch square, or 4 by 3 inch. Gates require to be well built, and be wide enough to permit a small cart to pass through. Hinges are not expensive and are economic if good. Neglect in application of firm catches or fasteners often causes loss. A very simple arrangement is to use stout bent wire which can be opened from either side. This is hinged loosely to the upright post, and fitted easily to the frame of the gate, resting upon a pin of wire driven through the last named. The two ends of the wire may be turned or ringed to form a handle.

Hygienic Conditions.—The importance of cleanliness cannot be too strongly emphasised. Dirt is said to be matter in the wrong place. Dirty conditions mean discomfort, encourage parasites, and cause disease. Where birds are on full range the only point needing consideration is that the house shall be systematically cleaned out. With all such buildings a desirable plan is to build these of treated timber, and to spray with disinfectant from time to time. In fixed houses the chief danger is in the outside runs. More failures have resulted from contaminated soil than any other cause.

A well-fed domestic fowl of the larger races will produce 80 to 90 lbs. of moist manure per annum, varying in accordance with the feeding. This manure is of considerable value in connection with cultivation of the land. If the birds are distributed it is utilised. Under intensive and semi-intensive conditions it is concentrated, and is in excess of the capacity of the land to turn into plant life. It is frequently found in smaller poultry yards that the top crust becomes little better than a manure heap. Such is fatal to success.

Alternate Yards.—Under the last named conditions something can be done in the way of prevention by use of alternate runs, each of which is vacated in turn sufficiently long to permit of cultivation by growth of grass or cropping, the latter of which is the more effective. The additional cost of erecting netting is much more than compensated by the results attained. Everything will depend upon the number of birds *pro rata* to the area occupied, whether by the use of scratching-sheds a considerable portion of the manure produced does not fall upon the runs and can be removed, and the system of cultivation adopted. Intensifity of animal life must be accompanied by equal, if not greater, intensification of plant growth if the balance of nature is to be maintained. That, plus effect upon the poultry by abnormality of their environment, no matter what the system adopted, will determine whether success can be permanently achieved.

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CHAPTER XXIII

MANAGEMENT OF BREEDING STOCK.

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MANAGEMENT OF BREEDING STOCK.

CAPACITY AND CAPABILITY—WHERE MANAGEMENT TELLS—CAUSES OF INFERTILITY—HATCHABILITY—NUMBER OF HENS TO MALE—CONTINUOUS OR INTERMITTENT MATING—NESTS—SEX INFLUENCES—MENTAL IMPRESSIONS—DURATION OF MALE INFLUENCE.

Under natural conditions the primary objects are adaptability to the environment, making for perfectability of the species and race, and reproduction. With respect to the former the less fit are eliminated. So far as the latter is concerned, with poultry whilst development of frame and muscle, i.e., edible flesh, are influenced by food supply and conditions, the eggs laid are few in number and for continuation of the race. Under domestication production becomes dominant, and most of all where specialised and intensified, otherwise the additional costs would not be met or profit attained. Hence the question of management in order, as far as is possible, to minimise whatever tends to reduction of constitutional vigour and to attain the maximum of returns. Again must be emphasised that production and reproduction are not the same. These are frequently antagonistic. Our present consideration is reproduction.

Capacity and Capability.—A common mistake is in regarding the number of eggs a hen may produce as indicative of her value as a breeder. Capacity to produce is generally, if not always, present to a much greater extent than the actual results would indicate. This question is further discussed in Chapter XXVIII. How far capability can be developed to a greater equality with capacity has yet to be proved. The factors which are at work for development of the inherent reserves are unknown save to a very limited degree. It would appear to be undeniable that in breeding operations it is of the utmost importance the first consideration must be the nature of the egg, namely,

whether it is fertile and contains the elements in sufficient quantity for embryonic and post-hatching development, that is, hatchability and liveability. Upon these points Professor Eugene Davenport says (1): 'For present purposes the animal body may be regarded as a colony of organs, each endowed with its own peculiar function, the life of the whole and of every member being dependent upon the degree of success with which each portion does its work. The whole is, therefore, as strong as its weakest member, and when the whole is put to work in service for man, that service will not only depend upon the functional activity of the special organ involved . . . but also upon the successful discharge of all vital functions when subjected to the unnatural strain involved in working under pressure. The point at which the machine will break down or fail to do successful work is, therefore, a matter of relative strength of parts.' The practical application of what is here stated is that, additional to suitability of environment, management in other directions must be satisfactory. It has been said that environment is permissive rather than assertive. What we have to do is to avoid to the utmost extent known to us those hindrances which adversely influence effective and complete reproduction. What these hindrances are may not be known. The effects are apparent. In too many instances these are created and not inherent.

Where Management Tells.—That there may be too much in the way of control is evident. One of the most successful poultrymen we have known explained as his secret that he left the birds largely alone. In this is a profound truth. He did not mean that they were neglected. Everything in reason was provided for them. He, however, gave full opportunity for expression of their instinct, helping them as far as he knew. When results were not equal to his expectations, the cause was sought for, and, if possible, remedied. Forcing was not resorted to. Selection was in accordance with the immediate conditions. In this way there was a steady advance in productivity without reduction of breeding values. Considerable differences in results are frequently obtained by breeders living under practically identical conditions. There must be capacity in the owner as well as the stock.

With adoption of pedigree breeding and intensification, and the operations are on an extensive scale, this question becomes more important. When the stock are of a rougher type, and are main-

tained under more natural conditions, they are equal to the harder environment. In that case they are usually less productive and more reproductive than those which are more carefully bred and fed. Unless, however, poultry husbandry can be developed by those who must make it profitable in the way of enhanced production, and thus to meet the higher costs, the volume of supplies will be sensibly decreased. As previously shown, the number of poultry is greater per acre on small than large holdings. That is a question of management.

Causes of Infertility.—In the case of breeding stock the question of supreme importance is not the number of eggs laid, but how far these possess the essential capacities for producing strong, healthy, virile young birds. Many eggs have not this capacity, in that these have not been fertilised by the male element. An infertile egg is a *rara avis* in a wild bird's nest. Whilst the average percentage of infertile eggs is greater under domestication, it is often found this is not serious, and may be due to individual influences of male or female. In some cases the males are unable to yield enough of the seminal fluid to fertilise a large number of eggs. In this respect, also, seasonal influences may operate. Fertility is usually lower in the autumn and winter than during the normal breeding season, that is, the spring months. It has been suggested that this is due to lessened nutritive values of green food and parasitic life. Further, the reproductive functions may be retarded in operation if the body is not in a condition so that the organs operate freely, as, for instance, when these and the tissues are covered with fatty deposits. Normally birds are harder and leaner when the breeding season arrives. As a consequence food supplies prior to that period should be of a nature compelling exercise of the digestive apparatus, and the birds be required to work for all that they obtain. As a fact where birds have range or very large runs there may be a reduction in quantity of supplied food. They will not lack nutrition, as this will be found by foraging. To ensure fertility a rest from laying is often desirable. An abundance of oxygen is necessary to fertility. Hence the housing question is important.

Hatchability.—A fertilised egg does not necessarily mean a chicken. Domestication has undoubtedly resulted in a largely increased number of eggs per hen, and, under the more intensive conditions, a much

higher proportion of embryonic mortality. What is commonly termed " dead in shell " is one of the most serious problems in respect to poultry husbandry on commercial lines. It is negligible among farmers and such as are able to keep their breeding stock on range. In these the germ has been vitalised. There is growth for a few hours or days when that is arrested and death ensues. How far this may be due to lack of vigour in the seminal fluid as a result of debilitated physical condition of the male, or to weakness in the female, or to lack of elements in the egg to supply materials for development of the embryo, cannot be stated. In this connection an important question arises, namely, that whilst under modern systems of breeding there has undoubtedly been stimulation of ovarian activity, leading to a much increased production of eggs, whether there has been a corresponding glandular activity in production of the albumin, i.e., the white of the egg which supplies the elements from which the body, feathers, etc., are formed. For example, if during the normal breeding season a hen's body has a capacity for producing, say, fifty eggs, each of which has an ample supply of the elements referred to, whether, supposing she lays a hundred eggs in the period named, there will be a corresponding increase of these elements, or that the supply for fifty eggs has to be divided among the hundred ? Should the latter be true that means every egg is deficient in its essential factors, which would be conducive to embryonic mortality. This is an important field for research, difficult though that would be.

In the absence of positive knowledge opinions are largely assumptions, even though these be founded upon experience and wide observation. It is evident that debilitation of constitution in the parent stock, from whatever cause it may arise, leads to death in shell, and the same is true in connection with chicken mortality, that is, lack of liveability. As contributory causes may be named—improper conditions during the hatching stage, want or excess of moisture, lack of attention on the part of the hen, or irregularity of the incubator, and that disease germs may be transmitted by the hen to eggs laid by her. A pregnant fact is that the average hatching by hens is higher than by incubators, and that the embryonic mortality is very much lower. This indicates, at any rate with eggs from highly bred stock, the artificial system is deficient in essential factors. At the same time,

with range bred stock their eggs vary in hatchability to a very small extent whether by hen or machine. This indicates that the responsibility for want of success depends mainly on the stock and the conditions under which the breeders are maintained.

Number of Hens to Male.—Vigorous males will serve from a dozen to a score of hens, often more, according to the season. Too few hens may be hurtful to them, as would be too many. There are other males which are incapable of fertilising eggs of more than a few mates. There is, of course, a difference in individual hens of the same breed. No static rule can be given which applies to each case. For utility poultry, as a rule, eight to ten in the heavier breeds, and twelve to fifteen in the more active, are safe. Monogamous mating is undesirable, unless the male is only allowed access to the hen for an hour or two per diem. If the hens appear to be distressed, showing this by loss of feathers on the back, more hens should be given at once. There is another cause of infertile eggs when birds are in confinement, and one which is often unsuspected, namely, that the male bird is insufficiently fed. His gallantry to the ladies of his harem leads him to see that these are fed before he partakes of any food. If the supply is limited, or the attendant is careless, the possibility is that he does not obtain his share. When the male is found to be losing flesh, he should be carefully observed.

Within recent years the system of mass breeding has been largely adopted. By this is meant that hens are kept in large flocks, say, from fifty to a couple of hundred, and that with these are mated in the breeding season a relative number of males. That is undesirable, even though the fertility may be satisfactory, from the fact that there is practically no selection, and that it is to a large extent promiscuous. It often leads to the male birds fighting, and to overstrain on the part of those birds which are best able to assert themselves over others. It is not to be wondered at if, as is frequently experienced under such conditions, embryonic and chicken mortality are high.

Continuous or Intermittent Mating.—Where hens are kept entirely for egg-production they lay equally well without the presence of the male. Further, the eggs are preferable for human consumption, and these do not deteriorate so rapidly. A question arises, however, in the case of those used for breeding, namely, the effect upon the system

as a result of merely permitting association of the two sexes for a brief period prior to and during the breeding period. Such arrangement greatly simplifies the work, and is economical in that there are no birds which are fed needlessly. There is, however, another aspect, namely, whether this denial of functional activity does not lead to loss of the reproductive power. Attention to this subject is to the effect (2) 'that what was called by Maupas the dynamic theory of conjugation is a satisfying of an inherent periodic physiological need of living matter, resulting in a renewal of the vigour of the cell.' Professors Geddes and Thomson in the same work say: 'Without surrendering the idea that conjugation . . . may serve to re-invigorate the protoplasm when the environment is not perfect, we are led to look about for some other part that conjugation may play in the life of the race. The suggestion has been made that it enables the organism to withstand changed environmental conditions—a view which may be readily combined with the idea of re-invigoration. . . . Or it may be that the process of conjugation is a source of variation by bringing about new combinations among the essential substances of the two conjugates. . . . When the conditions of life are untoward, conjugation is apt to occur, and it may be followed by new combinations of qualities, some of which are suited to the altered conditions of life. Conjugation promotes variations, and some of these pay by securing survival.' The question is one of practical importance to the breeder.

Nests.—Breeding hens should be provided with a larger number of nests *pro rata* to the flock, than is necessary with layers. Whatever conduces to the comfort of the birds at that time is helpful, though it does not mean they should be pampered. Special attention should be paid to cleanliness. Nest boxes are better if in a quiet place, so that the inmates may be undisturbed. Malformed and shell-less eggs are often caused by the hens being affrighted or interfered with. Probably more than is generally known.

Sex Influences.—From a very early period of human history there have been speculations upon the determination of sex, even as far back as the time of Aristotle. That there must be some influence which controls the sex of the future chicken that may be hatched from an egg is evident. This, however, is one of the many secrets which Nature has reserved, not for want of endeavour to find it out. Hun-

dreds of theories have been advanced—some with more, others with less probability. In a few instances there have been what appeared sufficient data to arrive at a workable plan for controlling the sex. Then, again, the elusiveness of the problem has revealed itself. In practice these theories break down. It has sometimes seemed as if conditional influence was supreme. One of the latest suggestions, and with some measure of probability, is that the food reserves of the mother is the determining factor in mammals. If that were the case, it would mean that the quality of the yolk in birds, as a result of better feeding, is what decides the sex, and that high condition tends to a greater proportion of females. Tests have not confirmed the theory. The breeder has to accept the fact that no method of controlling sex that is reliable is known. Nature appears to endeavour to maintain an equality of males and females. It would certainly be a great gain if it were possible to control the sex. Those engaged in egg-production would obtain the greater number of females, and such as are striving for meat would breed for a greater number of cockerels. Some years ago an instrument was introduced, the inventor of which claimed that it would tell the sex of even an egg. A few successful guesses were made. In practice, however, it hopelessly broke down.

Mental Impressions.—A very common opinion has been that mothers during the time of pregnancy are susceptible through sight to influences which affect the progeny. Scientific investigations have failed to reveal actual cases more than could be explained by ordinary variations. In the case of poultry, as the embryonic period is after the egg has been laid, the influence, if such existed, would be before the ovule had left the ovary. The breeder, therefore, may ignore such theories, as also what is known as telegony—that is, the influence of the first conception upon later progeny.

Duration of Male Influence.—Many observations have been made for the purpose of learning how long the influence of a male bird in respect to fertility continues. Among these was that by Professor J. L. Frateur, of Louvain University, Belgium. The first test was to discern how long eggs were fertile after removal of the male. Three lots of hens were tested. Whilst there were considerable variations—namely that in one lot three eggs laid on the eleventh day after dismating were all fertile, and, in another, out of three eggs laid on the

thirteenth day two were infertile—of two lots none were fertile after the fourteenth day, although the experiment was continued for four weeks. The second test was in the reverse direction. Five lots of hens were mated, with which had been no male for forty days. The results show that no egg on the first day was vitalised; on the second day seventeen eggs were laid, of which eight were fertile; after the second day the majority of the eggs were fertile. It may be assumed, therefore, that two clear days should be allowed after mating takes place before the eggs are used for hatching.

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CHAPTER XXIV

THE FEEDING OF POULTRY.

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THE FEEDING OF POULTRY.

IMPORTANCE OF FEEDING—FOOD CONSTITUENTS OR NUTRIENTS—DIGESTION AND ASSIMILATION—NATURAL FOOD—ARTIFICIAL FOODS—DIGESTIBILITY OF FOODS—ALBUMINOID OR NUTRITIVE RATIO—VALUE OF FIBRE—QUALITY OF DIFFERENT NUTRIENTS—THEORETICAL BELIEFS—VITAMINS—IODINE AND METABOLISM OF MINERAL SALTS—FEEDING SYSTEMS—FEEDING UNDER DIFFERENT CONDITIONS—MILK—GRIT—CHARCOAL—CONDIMENTS—NUTRITIVE RATIO FOR LAYERS—RATIONS.

The question of feeding poultry is of paramount importance. Three aspects of the subject naturally present themselves, namely, the effect of food upon the health of the stock, the quality and quantity of the produce, and the cost of production. Eggs and poultry enter largely into the dietary of the present generation and, therefore, the quality is the chief factor. Marketing of produce plays a very important part in the condition with which this article of food reaches the consumer, from the fact that food influences the composition of both eggs and flesh. Analysis of a number of eggs, for instance, may give the same results. It is, however, true that some eggs may be deficient in one or more of those ingredients which are only found in minute quantities.

Feeding bears directly upon the health of the stock. A point that has not been considered to any great extent, however, is the cumulative effect of any given system of feeding upon the reproductive capacity of the birds, whereupon depends the vigour and stamina of future generations. Much of the trouble as regards infertility, bad hatchability, and the heavy rate of mortality among chicks during their first six weeks, is due to deficiencies in the food supplied to the stock, not only during the breeding season but also throughout their entire lives.

Poultry keeping is a business to-day. The cost of production,

therefore, is involved. Cost of feeding must always be regarded as in direct relation to the rate of production. Under existing conditions artificial foods must be provided for all utility fowls. Feeding can only be successful when production is sufficiently high to leave a good margin of profit between the value of the produce and the cost of food supplied.

The claim, so often made, that we are in possession of a vast fund of knowledge regarding this important subject is unwarranted. The truth must be confessed that we are only beginning to understand the rudiments of the subject. What knowledge is available at the time of writing is given here, and, valuable though this information is, until such time as research workers obtain more facts from reluctant nature, we are compelled to feed our poultry in accordance with practical experience, as has been the case in the past.

Food Constituents or Nutrients.—All foods, whether natural or artificial, are composed of various groups of compounds. From the chemists' point of view these may be classified as (1) Water; (2) Nitrogenous Matter or Proteins; (3) Carbohydrates; (4) Fats; (5) Fibre; and (6) Ash, or Mineral Matter.

1. Water: Moisture is an essential nutrient, and an important component of the body. It is necessary for all processes in which a solvent is required; it also enters largely into the composition of the eggs which are laid by hens; and a considerable quantity is lost in the excretions and the exhaled breath. Water is formed in the body by the oxidation of the various organic nutrients, but the quantity so produced is infinitesimal and need not be considered. Birds are not provided with sweat glands. It is believed now that the temperature of the body is regulated by the variable evaporation of moisture from the lungs; hence the need for more water in hot weather. The importance of its purity cannot be too strongly emphasised.

2. Nitrogenous matter or Proteins: This group of compounds consists of substances of a very complex organic nature. They form feathers, skin, blood, muscle and a large portion of the egg. Proteins contain carbon, hydrogen, oxygen and nitrogen, while sulphur is usually present, and in many cases traces of phosphorous are found. The thousands of different forms of protein vary greatly in composition, but all possess two main characteristics in common, these being (1)

a definite percentage of nitrogen is present in all (16 per cent), and (2) they are all composed of substances known as the amino acids. The importance of this group of nutrients will be realised when it is stated that 20 per cent of the live weight of a bird, and 50 per cent of the dry weight consist of protein. Something like twenty of the amino acids are known, but all are not contained in the same food. For instance, maize is lacking in two highly important amino acids, and, as it is essential for all to be present to make a complete food, fowls cannot be fed upon this one grain alone. After digestion—this question is dealt with later in the chapter—the blood conveys the amino acids to every part of the body where they are reconstructed into body proteins. If an excess of protein be supplied all enters the blood stream in the form of amino acids, and on passing through the liver that which is not required is deprived of its nitrogen and transformed into fats and carbohydrates. Only the nitrogen, therefore, in the excess of protein is wasted. On the other hand, carbohydrates and fats cannot be transformed into proteins when this nutrient is deficient. They have not the power of taking up nitrogen. A protein deficiency in the food is, therefore, serious in respect to the body maintenance and production.

3. Carbohydrates: These substances are heat and energy providers. Only three elements enter into their composition, namely, carbon, hydrogen and oxygen. The two last mentioned are always in the same proportion as found in water, that is, two parts of hydrogen to one part of oxygen. Included in this group are the starches, sugars and celluloses. The celluloses need not be considered in this connection, since they are not acted upon by the digestive juices, and, therefore, do not assist in the direct nourishment of the body. They are dealt with later. During digestion the starches and sugars are broken down into a simple form of sugar which is oxidised by the oxygen carried by the hœmoglobin in the blood to carbon dioxide and water, while heat is generated. The life of the bird is absolutely dependent upon heat production. The carbohydrates are utilised comparatively soon. Any excess supplied is stored up in the liver and muscles in the form of fat, which, as occasion demands, may be transformed once more into carbohydrates.

4. Fats: These compounds also contain the same three elements

as the carbohydrates, namely, carbon, hydrogen and oxygen, but the oxygen is present in a smaller quantity. They are composed of the fatty acids and some form of alcohol. Fats, too, are used in the bird body for the production of heat and energy, as well as for the oily secretions at the joints and under the skin. The value of the carbohydrates and fats as heat producers is dependent upon the proportion of carbon and hydrogen present, since the heat is generated by the oxidation of these two elements. It will be understood, therefore, that a given weight of fat is more valuable than an equal weight of carbohydrates. Carbohydrates contain about 50 per cent of oxygen, and the fats only about 11 per cent. The proportion between the carbon and hydrogen also varies. Experiments have proved that 1 lb. of fat produces the same heat as 2¼ lb. of carbohydrates. When an excess of fat is fed the unused portion is stored up under the skin, in the abdominal cavity, and on certain organs of the body, such as the kidneys.

5. Fibre: The fibre consists of cellulose; that is, the form of carbohydrates of which the cell walls are constructed. It is composed of carbon, hydrogen and oxygen—the two last mentioned being in the same proportion as found in water—but it is wholly indigestible in the case of poultry, as demonstrated by recent research. That a certain amount of fibre is advantageous is, however, undoubted as explained later.

6. Ash or Mineral Matter: Mineral matter is found in all parts of the bird body, including the bones, organs, tissues and fluids. It is essential for growing birds, as it is for laying stock, in the formation of egg shells, and the renewal of their tissues which are, of course, subject to wear. Numerous minerals are present in the body. Calcium, magnesium and phosphorous are found in the bones. Calcium is a constituent of the blood, as it is also of the white of the egg and egg shell. Phosphorous is present in egg yolk. All plant eating animals and birds require sodium chloride (common salt) for the elimination of the excess of potassium in the food. Sodium chloride and potassium chloride are present in the tissues and body fluids. Silicon and sulphur are needed for feather formation. Iron is a very important ingredient in the blood, as it renders possible the hœmoglobin to carry oxygen. It is also present in eggs. Other minerals are found in

minute quantities, such as copper, arsenic and zinc, and iodine is present in the thyroid gland. A valuable source of calcium is oyster shell and, containing as it does traces of iodine, this substance should be provided, adequate quantities always being kept before the birds in a crushed or broken state. Very little is known as yet concerning the metabolism of the various minerals. It is believed that iodine plays a very important part in this connection and, therefore, further reference is made to this substance later. Any excess of mineral matter supplied is disposed of through the excreta as the bird body is incapable of storing it. Continuous supplies are, therefore, necessary.

Digestion and Assimilation.—All feeding stuffs are composed of insoluble matter. Before these can be utilised by the bird body they must be rendered soluble, that is, be digested, and caused to enter the blood stream. In this way they are assimilated. These processes may be briefly described.

The food enters the digestive tract through the mouth and is passed into the crop through the œsophagus. Here it is mixed with a secretion similar in many respects to the saliva of mammals, which acts upon the carbohydrates converting or transforming them into sugars. The food continues its passage to the stomach, where another juice—the gastric—is poured upon it thus re-acting upon the proteins. After leaving the stomach the food is ground in the gizzard and then passes into the small intestine. Here two more secretions—the bile and the pancreatic juice—are mixed with the food. These juices emulsify the fats, but at the same time they act upon the carbohydrates and proteins, continuing the work of digestion started by the saliva and gastric juice. All digestible constituents in the food are, therefore, rendered soluble.

At this stage, although a large portion of the food is in a soluble state, it is accepted to be outside the body. Before the products of digestion, as they are termed, can be used they must be taken up by the blood stream. Assimilation is brought about in two ways. Part is absorbed directly through the many small veins that intersect the walls of the intestine ; the remainder are absorbed by the villi, or the organs in the wall of the intestine which are connected with the lymphatic system. After traversing the lymphatic system the products of digestion absorbed by the villi are poured into the blood in the jugular vein.

Natural Food.—The wild progenitors of present-day races of poultry subsisted entirely upon the materials which they were able to obtain for themselves. Natural food should, therefore, be the basis of feeding. Seeing, however, that domesticated fowls are expected to be more fecund, the supply of natural food must be supplemented by artificial feeding stuffs. It is held by many to-day that the future of profitable egg-production lies in the hands of the farming community, since, with an unlimited range, the cost of production should be considerably less than under commercial poultry farming conditions, in which case a large proportion of the foods have to be purchased, while the general health of the stock should be more easily maintained. This is, however, by the way. The difficulty which presents itself in this connection is that there is no exact knowledge regarding the nature of the natural food that is available upon more intensive farms. It is known, however, that natural food contains, among numerous other substances, worms, slugs, insect life, seeds, lime, various salts, and grit. The proportion in which they are gathered is not known, nor how they vary on different soils and at different periods of the year. There is a need for research in these directions. It is realised, however, that natural food obtained is highly nutritious, and that, at the same time, the birds clear the soil of injurious insect and other pests, besides which they supply manure to the ground. Natural food must be supplemented by artificial feeding stuffs. It is, however, likely to be a vexed question for many years as to how far one is justified in feeding additional artificial foods with a view to increasing production. It may be taken, however, that where increased production is sufficient to compensate for the extra cost, all other things being equal (specially as regards the health of the stock), commercial poultry keeping is profitable.

Artificial Food.—A very large number of artificial foods may be used for poultry feeding, the determining factor being their market value. In the following table a list of the principle feeding stuffs is given, together with their analyses :—

TABLE I

Analysis of Feeding Stuffs.

Foods	Water	Albuminoids or Nitrogenous Matter	Fats	Carbo-hydrates	Fibre	Ash	Organic matter (without fibre)	Albuminoid or Nutrient Ratio
Artichokes (Jerusalem)	80·0	2·0	0·2	15·5	1·3	1·0	17·7	1 : 8·0
Barley	14·0	7·7	2·3	56·1	4·9	2·7	66·1	1 : 8·0
Beans	14·0	24·0	1·5	48·0	2·5	10·0	73·5	1 : 2·1
Beans (Soya) ...	10·80	34·0	16·9	28·8	4·7	4·8	79·7	1 : 2·0
Beanmeal	14·5	23·0	1·4	43·6	9·4	3·1	68·0	1 : 2·0
Brewers' grains ...	76·6	3·9	0·4	9·5	6·2	1·2	13·8	1 : 2·7
Brewers' grains (desiccated) ...	12·0	18·7	8·1	49·0	7·9	4·3	75·8	1 : 3·3
Buckwheat	14·0	6·8	1·2	44·0	15·0	1·8	52·0	1 : 6·9
Buttermilk ...	90·1	3·0	1·0	5·4	—	0·5	9·4	1 : 2·5
Cabbage	89·0	1·1	0·2	6·0	2·0	1·2	7·3	1 : 5·9
Clover hay	16·0	4·5	2·2	34·6	26·5	6·2	51·3	1 : 2·7
Cow's milk (separated)	90·5	3·9	0·4	4.5	—	0·7	8·8	1 : 1·4
Cow's milk (skimmed) ...	90·0	3·0	0·6	5·6	—	0·8	9·2	1 : 2·3
Dari	8·9	13·1	4·6	67·1	1·9	4·4	85·8	1 : 5·9
Hempseed	12·2	12·2	30·2	15·0	12·1	4·5	57·4	1 : 6·9
Lettuce	93·0	0·7	—	4·7	0·6	1·0	5·4	1 : 7·0
Linseed	12·3	17·2	35·2	15·3	7·2	3·4	67·7	1 : 5·5
Linseed-meal (extracted)	9·7	28·7	4·0	29·4	6·7	7·3	62·1	1 : 1·3
Lucerne (green) ...	74·0	3·2	0·3	9·1	9·5	2·0	12·6	1 : 3·1
Lucerne hay ...	16·5	12·3	0·9	31·4	26·6	6·8	44·6	1 : 2·7
Maize	14·4	8·4	4·8	57·8	5·5	1·5	71·0	1 : 8·2
Mangold-wurzel ...	88·0	1·1	0·1	9·1	0·9	0·8	10·3	1 : 8·5
Meal (granulated) ...	—	63·24	13·32	—	—	—	—	—
Millet	14·0	9·5	2·6	43·1	9·5	3·0	55·2	1 : 5·2
Oats	14·3	9·0	4·7	41·8	9·3	2·7	55·5	1 : 5·8
Oatmeal	10·5	8·5	3·6	48·2	14·5	6·8	60·3	1 : 6·6
Peas	14·3	20·2	1·7	49·9	6·4	2·4	71·8	1 : 2·7
Peameal	11·4	20·9	2·8	55·4	4·5	3·5	79·1	1 : 3·0
Potatoes	75·0	2·1	0·3	20·6	1·1	0·9	23·0	1 : 10·1
Rape forage ...	87·0	2·0	0·4	4·8	4·2	1·6	7·2	1 : 2·85
Rice	14·0	6·9	0·3	72·7	2·2	0·5	79·9	1 : 10·6
Sunflower-seed ...	8·0	11·1	21·2	28·1	28·5	3·0	60·4	1 : 6·9
Turnips & Swedes	89·4	1·3	0·1	6·3	1·3	0·6	7·7	1 : 5·0
Wheat	14·4	11·7	1·2	64·3	3·0	1·7	77·2	1 : 5·7
Wheat bran ...	13·6	10·6	2·4	44·4	8·9	5·6	57·4	1 : 4·7
Wheat middlings ...	12·5	14·6	3·4	61·6	4·7	2·9	79·6	1 : 4·75
Whey	93·2	0·8	0·3	5·0	—	0·6	6·1	1 : 7·1

Digestibility of Foods.—It is of importance that the poultry keeper should study the analyses of various feeding stuffs, at the same time too much value should not be given to the figures in the foregoing table. The composition of an individual food frequently varies considerably according to the country, and even perhaps the district, in which it is grown. The quality of the samples purchased differs. A good sample of wheat contains more carbohydrates than a poor sample; a poor sample of oats or barley contains a greater proportion of fibre than a good one; milling methods differ in various localities; many meals are adulterated; and, lastly, but most important of all, the table does not give the percentage of the various groups of compounds which are digestible.

To determine the digestible constituents of a food it is essential to feed definite amounts of an analysed sample, and again analyse the excretions. The nutrients fed and not excreted are taken as actually digested; those present in the excreta are accepted to be indigestible. The difficulties which beset the experimenter in connection with poultry feeding are great, since the excreta consists of a combination of feces and urine. Therefore, little has been attempted to determine the digestibility of foods when taken into the bird body. There is a vast difference between various kinds of animals, even with species of fowls. Consequently analyses giving the digestible constituents of food for any stock other than poultry cannot be accepted. Very little research work has been carried out in this connection with poultry, the knowledge that is available is the result of the labours of Katayama (1), Voltz and Yakuwa (2), and Voltz and Dietrich (3), as quoted by Holst and Newlon (4).

The analyses of the feeding stuffs experimented with by Katayama, Voltz and collaborators were as follows :—

TABLE 2

The Per Cent Composition of Feedstuffs Used in Digestibility Trials with Poultry.

Feedstuff	Moisture	Minerals	Organic substance	Crude Protein	Nitrogen-free extract *	Crude fat	Crude Fibre.
Barley	12·33	2·88	84·79	13·93	64·16	1·80	4·90
Corn	13·00	1·30	85·70	9·90	69·20	4·40	2·20
Fish Meal	9·89	12·30	77·81	61·93	2·57	13·31	—
Meat Scrap...	9·32	17·15	73·53	50·24	2·21	16·15	4·93
Potatoes	74·69	1·39	23·92	1·84	21·23	0·10	0·75
Rice, unpolished	11·65	1·72	86·63	10·45	73·52	1·93	0·73
Rice bran	11·05	11·43	77·52	14·13	35·96	19·31	8·12
Rye	15·32	1·98	82·70	9·83	69·02	1·65	2·20
Soybean meal	10·79	6·21	83·00	42·68	28·76	7·23	4·33
Wheat	13·42	1·92	84·66	14·03	66·47	1·93	2·23
Wheat bran	12·40	5·41	82·19	14·87	54·25	4·06	9·01
Yeast	8·73	6·66	84·61	55·44	26·44	2·73	0·50

(* Otherwise Carbohydrates)

Working with the samples, the analyses of which are given in Table 2, Katayama found as the average of a number of experiments with wheat bran fed to poultry that the following were the digestibility co-efficients :—

Organic Substance	Protein	Carbo-hydrates	Fat	Crude Fibre
55·3	64·3	61·2	55·6	0

In simple language this means that of each 100 parts of organic substance—the organic substance is the gross weight of food fed, less mineral content and moisture—44.7 parts were passed out in the excreta ; that is, 55·3 parts were digested. The co-efficient of digestibility of the organic substance, therefore, for poultry is 55·3. In the same way he found that out of every 100 parts of crude protein 35·7 parts were lost, or 64·3 parts digested; of every 100 parts of carbohydrates 38·8 were lost or 61·2 digested ; and of every 100 parts of fat 44·4 parts were lost or 55·6 parts digested.

All of the feeding stuffs enumerated in Table 2 were experimented upon and the results of these are tabulated in Table 3, as follows :—

TABLE 3

Digestibility Co-efficients for the Different Nutrients of Common Feedstuffs for Poultry.

Feedstuff	Organic Substance	Crude Protein	Nitrogen-free extract*	Fat	Crude Fibre
Barley	75·4	75·1	82.2	48·0	0
Corn	86·2	58·0†	93·0	8·53	0
Fish meal	88·9	90·6	—	98·2	0
Meat scrap	76·6	73·6	—	82·1	0
Potatoes	78·3	46·9	84·5	—	0
Rice, unpolished ...	78·0	76·9	88·1	64·1	0
Rice Bran	59·7	66·9	58·2	87·7	0
Rye	79·2	63·0	85·6	28·5	0
Soybean meal ...	76·6	83·4	75·3	84·1	0
Wheat	84·3	78·9	89·3	39·8	0
Wheat bran	55·3	64·3	61·2	55·6	0
Yeast	75·5	76·2	82·8	57·1	0

(*) Otherwise Carbohydrates.

(†) This figure was obtained by a different method which possibly gives a somewhat low value.

When compounding rations it is more convenient when the particulars are given for the pounds of digestible nutrients in 100 pounds of food. These figures can be worked out quite easily from Tables 2 and 3. Taking wheat as an illustration the percentage of digestible nutrients may be calculated as follows :—

From Table 2 we find that in every 100 pounds of wheat there are 84·66 pounds of organic substance, this consisting of 14·03 pounds of crude protein, 66·47 pounds of nitrogen-free extract or carbohydrates, 1·93 pounds of crude fat and 2.23 pounds of crude fibre. The digestible organic nutrients in 100 pounds of wheat, therefore, are

$$84{\cdot}66 \times \frac{84{\cdot}3}{100} = 71{\cdot}37 \text{ pounds.}$$

the 84·3 above the line being the co-efficient as given in Table 3.

Corresponding figures for protein are given by $\frac{14{\cdot}0 \times 78{\cdot}9}{100}$ or

11·07 pounds; for carbohydrates $\frac{66.47 \times 89{\cdot}3}{100}$ or 59·36 pounds; for fat $\frac{1{\cdot}93 \times 39{\cdot}8}{100}$ or 0·77 pounds; and for fibre 0 pounds.

The sum of the digestible proteins, carbohydrates and fat should, of course, equal the total digestible organic substance, but, owing to unavoidable experimental errors, there is always a slight discrepancy. In the case of wheat, cited above, this amounts to 0·17 pounds.

By following the same method with the various feeding stuffs, mentioned in Table 2, and employing the digestibility co-efficients given in Table 3, the percentage of the digestible nutrients can be calculated. These are given in tabular form, as follows:—

TABLE 4.

Pounds of Nutrients Digestible to Poultry in 100 pounds of Feed (Based on Composition of foods as given in Table 2).

Feedstuff	Organic Substance	Protein	Nritrogen-free extract*	Fat
Barley	63·93	10·46	52·74	0·86
Corn	73·87	5·74	64·38	3·75
Fish meal	69·17	56·11	—	13·07
Meat scrap	53·03	36·98	—	13·24
Potatoes	18·73	0·86	17·94	—
Rice, unpolished ...	74·05	8·04	64·77	1·24
Rice bran	46·28	9·45	20·93	16·93
Rye	65·50	6·19	59·08	0·47
Soybean meal	63·58	35·61	21·65	6·08
Wheat	71·37	11·07	59·36	0·77
Wheat bran	45·44	9·56	33·20	2·26
Yeast	63·88	42·25	21·89	1·56

* Otherwise Carbohydrates.

In connection with the question of the digestibility of food it is advisable to point out that one of the effects of cooking is to decrease the percentage of digestible proteins, but to what extent this takes place has not yet been determined. On the other hand, cooking exerts a beneficial influence upon the starches and is thought to be desirable with feeding stuffs which contain a considerable proportion of fibre. Whether cooking is advisable or not is open to discussion. It is probably advantageous to supply wet mash in a warm state during cold weather, since a certain amount of body heat must be utilised for

raising the contents of the digestive tract to the same temperature as the body itself. This body heat is directly supplied by the food, and, therefore, to feed a cold wet mash implies a food wastage. Also warm food is attractive at that season of the year. In addition to the probable effect which cooking has upon the proteins, rendering a portion of them insoluble, the fact must not be overlooked that the vitamin content may also be destroyed in great measure. There is, moreover, a distinct possibility that a cooked food does not exercise the digestive organs to the same extent as one that is uncooked and this may well prove harmful to the bird body.

The Albuminoid or Nutritive Ratio.—To feed poultry successfully, from the scientific point of view, it is essential to take into consideration the balance between different organic nutrients ; that is, the proteins, carbohydrates and fats. It is necessary to determine the albuminoid or nutritive ratio, namely, to find the ratio between digestible proteins on the one hand and digestible carbohydrates and digestible fats on the other hand. That is, to learn the ratio between the available body building material and the heat and energy producers.

To calculate the nutritive ratio it is essential to bring the fats into terms of carbohydrates. It has been pointed out previously that 1 lb. of fat is equal to $2\frac{1}{4}$ lb. of carbohydrates : therefore, this must be taken into account. The nutritive ratio is worked out as follows :—The percentage of fats present in any given food is multiplied by 2.25, is added to the percentage of carbohydrates, and the answer divided by the percentage of proteins. One illustration will make this clear.

The analysis for wheat in Table 2 gives protein as 14·03 per cent, carbohydrates 66·47 per cent and fat 1·93 per cent. By multiplying the 1·93 by 2.25 and adding to the carbohydrates, 66.47, we arrive at a total of 70·81. When this is divided by the percentage of protein present, 14.03, it is found that the ratio between the proteins on the one side and the heat and energy producers on the other is as 1 to 5. This, therefore, is known as the nutritive ratio.

If the nutritive ratio be worked out, however, from Table 4, which gives the digestive percentages, we find that the ratio is broader, that is, there is a smaller proportion of protein. The percentage of digestible fat, 0·77 is multiplied by 2.25, and the answer is added to the percentage of digestible carbohydrates, giving a total of 61·09. This

is divided by the digestible proteins, 11·07, which indicates a nutrient ratio of 1 to 5·5. This one illustration will demonstrate the importance of knowing the percentage of the digestible nutrients when compounding rations.

The nutritive ratio of a mixture of different feeding stuffs is calculated in exactly the same manner. In this case the total digestible proteins, carbohydrates and fats are taken, as in the following example:

Let it be said that we are feeding a mixture of 50 lb. of wheat, 50 lb. of barley, 50 lb. of yellow corn, and 20 lb. of fish meal. On reference to Table 4 we find the percentage of the digestible nutrients for 100 pounds. These figures must, therefore, be divided by 2, since only half the quantity is being taken. In the case of fish meal where only 20 lb. is used the figures relative to this food must be divided by 5. This gives us the following :—

Foodstuff		Protein	Carbohydrates	Fat
Wheat, 50 lb.	...	5·535	29·68	0·385
Barley, 50 lb.	...	5·23	26·37	0·43
Corn, 50 lb.	...	2·87	32·19	1·875
Fish meal, 20 lb.	...	11·22	—	2·614
		24·855	88·24	5·304

$$5{\cdot}3\ (\text{fat}) \times 2{\cdot}25 + 88{\cdot}24 = 100{\cdot}165$$

$$100{\cdot}165 \div 24.85 = 4$$

The nutritive ratio of the mixture is, therefore, 1 to 4.

The Value of Fibre.—By far the greater proportion of undigestible food is crude fibre. Although as shown in the previous tables no fibre is digested in the bird body, it still possesses a certain value. Experiments have indicated that birds cannot exist on pure digestible nutrients alone; they must have a quantity of fibre to give bulk to the food. Why this should be so is not yet understood, but it is assumed that the fibre acts as a stimulant to the secretion of the digestive juices, and exercises the digestive apparatus. It is impossible to say how much fibre should be present, since good results have been secured with food mixtures containing as little as 3 per cent, and equally good results with foods containing as much as 10 per cent. The majority of the most satisfactory rations employed, however, generally contain about 6 per cent. The presence of an adequate

quantity of fibre in the food may also be an important factor in digestion, since it undoubtedly brings about more exercise in the digestive system. No tests have been carried out, however, in this connection and, therefore, definite facts cannot be stated.

Quality of Different Nutrients.—Although there is no fundamental difference between vegetable and animal proteins there is variation in values. This is due to the fact that the comparatively large quantity of cellulose in vegetable proteins hinders digestion to a certain extent. This is shown in Table 3, since 90·6 per cent of the crude protein in fish meal is digested, for instance, whereas only 78·9 per cent of the crude protein in wheat is acted upon by the digestive juices. It is possible to feed birds successfully however, on vegetable proteins alone. (5) (6) (7). In practice it is found advisable to use not less than 4 per cent of animal food, since this exerts a peculiar influence upon the secretion of the digestive juices, pointed out by Holst and Newlon (4), as it causes more rapid digestion. When animal protein is not more than 10 per cent dearer than vegetable protein, it is, however, better to supply a larger amount of the former.

All carbohydrates are alike and, therefore, it does not signify whether these are of animal or vegetable origin.

Animal fat is more easily digested by birds than vegetable fat, although there is no conspicuous difference between the two. This is due to the fact that animal fat is more accessible to the digestive juices than vegetable fats, owing to the presence of cellulose in the latter. Table 3 indicates this, since 98·2 per cent of the fat in fish meal is digestible, whereas only 39·8 per cent of the fat in wheat is made use of by the bird body.

Theoretical Beliefs.—A conclusion is only a theory until it has been proved to be a fact. Much excellent work has been done during recent years in connection with poultry feeding. It must be owned that at the moment scientists are just beginning to elucidate the true meaning and importance of a number of elusive agencies which appear to be at work. Two questions of outstanding importance relate to the vitamins and the metabolism of the mineral salts.

The Vitamins.—The physiological importance of the vitamins and their main sources are fairly well understood; their chemical composition is, however, still a mystery. The vitamins—five are already

known, these being termed by the first letters of the alphabet—exist in minute quantities. They appear to play a highly important part in nutrition. It is commonly supposed that they are not actual structural components, but that they are catalytic agents: that is, the effect is produced by their mere presence with little or no loss of substance. The vitamins are all more or less unstable, a fact which indicates that a continuous supply is essential. Only one of the five known vitamins—(fat-soluble A)—can be stored in the bird body, and this only in very small quantities; no benefit arises, therefore, from an excessive supply.

VITAMIN A—(fat-soluble A) is known as the growth vitamin. Without an adequate supply growth is stopped. In addition, a deficiency of this vitamin affects the secretory glands of the eyes, mouth, nose and throat and, as the secretions are germicides to a limited extent, it may well be that this is the cause of the condition known as nutritional roup. In fact, the complaint named has been prevented and cured by increasing the allowance of vitamin A Beach (8) and Davis and Beach (9). Vitamin A is found in green food, the embryos of numerous seeds (linseed, yellow corn or maize, and millet), tomatoes, yellow carrots, and animal fats, such as butterfat, egg-yolk-fat and high-grade cod liver oil. It is also present in dried alfalfa when the curing conditions have been favourable.

VITAMIN B—(anti-neuritic factor or water-soluble B) is the most widely distributed of all the vitamins. It is found in the germ and bran of all grains, in fresh vegetables, green food, milk, egg yolk and yeast, the last mentioned being particularly strong in this vitamin. A lack of this vitamin—which is not likely under modern feeding conditions—tends to decrease the food consumption, and, later, produces symptoms similar to beri-beri in humans, in which cases paralysis of the limbs is one of the best known. It is possible for this complaint to show itself in the case of poultry, especially in the late summer and early autumn when the pasture over which the free range birds are running is dried up; it also appears in winter when the supply of fresh green food for the semi-intensively kept stock is inadequate and the mash does not contain a reasonable proportion of meat, fish or milk products. There is, however, no reason why the birds should be deprived of these essential articles of food.

VITAMIN C—(the antiscorbutic vitamin or water soluble C) is not considered to be of any importance in the case of fowls, since the lack of this produces a disease known as scurvy—one to which poultry are not subject.

VITAMIN D—(the antirachitic factor) is, perhaps, the most interesting of the five known vitamins, since its place can be taken with equal results by the ultra-violet rays in sunlight. This vitamin is found to a certain extent in animal fats—associated with fat-soluble A—but the main source of supply is cod liver oil, although it is present in hay when this has been made by long exposure to the sun. Lack of vitamin D causes rickets in humans. The chief characteristics of this disease is a disturbance of the utilisation and retention of lime salts in the body. In the case of growing birds the first sign of a deficiency of vitamin D is leg-weakness. Adult birds suffer in the same way. It is well known that a laying fowl will often utilise the lime in its own bones, which is supposed to be one of the causes of crooked breast bones in heavy producers. Without a sufficient supply of this vitamin it is believed that, although there may be an abundance of calcium in the food, it cannot be made use of by the bird body. In this connection it must be mentioned here—the subject is dealt with at length below—research indicates that iodine, also, plays a very important part in calcium metabolism. A lack of mineral salts in the food will, of course, produce the same results.

Vitamin E is now believed to exert a vast influence upon the reproductive organs of animals, but only little information is available in this connection.

Iodine and the Metabolism of Mineral Salts.—The conclusion now arrived at by numerous experimenters is that a large amount of mortality and ill-health in stock is due to a lack of iodine in the food. The iodine present in the bird body is found in the thyroid gland, and, according to Dr. Goodfellow (10), the secretion from this gland, which is taken to mean iodine, is, in the case of humans (1) essential to physical growth ; (2) necessary for mental development ; (3) specially required in the pregnant condition ; (4) needed at the age of adolescence for the development of the reproductive organs ; (5) essential to the health of the skin, hair and the like; (6) required for the digestion, assimilation and combustion of fats ; (7) necessary for the metabolism of calcium,

excess lime demanding additional iodine for its proper assimilation, and (8) needed to establish and maintain resistance to bacterial infection and toxins. The majority of these points have a direct bearing on poultry keeping. It would be out of place here to enter into a long discussion with reference to the numerous experiments that have been conducted, but a few brief instances of its importance may be given.

Three experiments carried out at the Iowa State College of Agriculture with pigs demonstrate that when iodine was supplied to these animals in an adequate amount the animals consumed less food and made far better use of what they did consume than the control animals (11). A pedigree cattle breeder in South Africa (12) administered iodine to two thriftless and hand-reared calves, and at seven months they had passed the best of the non-iodised animals. Results at the Oberholz Experimental Station of Leipzic University with sheep gave similar results (13).

If it be true, as Koepimau (14) says, that " If one feeds animals an insufficiency of iodine they will give birth to young of poor physique, but if one gives these young plenty of iodine they will become normal," and if it be equally true that a severe shortage of iodine in the food of female animals will prevent their giving birth at all, as stated by Corrie (15), it would appear that an adequate supply of iodine is essential for laying birds and breeding stock alike. Caerity (16) has shown that the daily administration of a few drops of 7 per cent tincture of iodine given to fowls resulted in a flock average of 70 per cent in early September with March hatched pullets.

With sheep and pigs iodine has been demonstrated to have a marked influence upon the wool and hair. There is a possibility that lack of iodine is the cause of slow feathering with young growing stock.

Hill (17) has shown that softening of bone known as osteomalacia is a deficiency disease. Although it is commonly put down to a lack of calcium salts or phosphorous or both, it is remarkable that it has been cured by the administration of iodine alone. Laying fowls require a considerable quantity of calcium for the egg shells. An interesting point to note, therefore, that The Staffordshire Farm Institute (18) state that they " confirm the idea held in many quarters that an increase in the supply of calcium without a corresponding increase of iodine supply has a detrimental effect in nutrition."

In connection with the question of iodine and resistance to disease the tests carried out with in-pig sows at the Royal Experimental Station (Animal Physiology) Budapest (19) are illuminating. The percentage of deaths among the young with the non-iodine group was over 50 per cent; with the iodine group under 3 per cent. Only 42 per cent of the non-iodine group were reared and weaned; 82 per cent of the iodised group were reared. The average weight of the non-iodine group pigs at weaning time was 30¾ lb.; of the iodised group just over 39 lb.

Only a minute quantity of iodine appears to be necessary. There is only from 40 to 50 milligrammes present in the gland of a normal sheep; that present in the gland of a fowl should be considerably less. Corrie (15) suggests that an ample allowance for an adult fowl is 2 grams, or 30 grains, per annum.

Feeding Systems.—There are various systems of feeding poultry in use to-day. These are the wet mash and grain method; the dry mash and grain method; a combination of these two; and all mash feeding.

When wet mash and grain are fed under semi-intensive conditions it is customary to provide the grain in the morning, burying this in the litter with a view to giving the birds exercise, and to supply the wet mash as a last feed. When birds are kept on a free range the order is generally reversed, the wet mash being given as a morning meal. The main advantage of this method is that cooked vegetables and house scraps may be incorporated with the mash. The labour involved is considerable.

Dry mash feeding reduces labour to a great extent, since the mash is constantly in front of the birds in self-feeding hoppers. Part of the grain ration is supplied in the morning; the remainder as a last feed, the division generally being ⅓ and ⅔ respectively.

So far as experience goes equal results are obtained from these two methods, provided the mashes are compounded of suitable ingredients.

With a view to encouraging layers to consume more food, many poultry keepers to-day adopt the dry mash system of feeding, and in addition provide a small feed of wet mash in the middle of the day. This method has not been tried sufficiently to warrant an opinion being expressed as to its value.

All mash feeding is still in its experimental stage and, therefore,

it may be mentioned as a possible method. The one objection that may be raised to it at this stage is that to effect a slight change in the composition of the food the whole mash must be altered. This renders feeding more difficult (see Nutritive Ratio for Layers later in chapter).

Feeding under Different Conditions.—Fowls are kept extensively, semi-intensively and intensively. Free range birds are able to gather a considerable amount of natural food, this varying with the nature of the soil, the season of the year, and the weather conditions. Although but little is known definitely regarding the nature of natural food, it may be taken that it is more or less well-balanced and provides for the needs of the bird body in all ways, since it constitutes the ordinary food of wild birds. Further, it is supposed that natural food contains a sufficient supply of those substances which are needed by the bird body in infinitesimal quantities, such as the vitamins and iodine, together with mineral salts.

Feeding on Free Range.—If the above assumption be correct, as we have every reason to believe, the question of augmenting the natural food supply by the use of artificial feeding stuffs is simplified. The whole question devolves into one of quantity. It is possible, therefore, to supply the free range fowls with exactly the same mixtures of meals and grains as to those kept semi-intensively and intensively. The poultry keeper is, furthermore, saved the trouble and worry of arranging for an adequate supply of vitamins, mineral salts and iodine. Feeding must, however, be carried out with discrimination, since an allowance must always be made for the varying supplies of natural food. For instance, when the ground is frozen hard or covered with snow it is essential to make good the deficiencies by the artificial foods provided ; feeding at such times should be the exact counterpart of supplying intensively kept birds. The poultry keeper must be guided by his own judgment. The outstanding fact is that the bird body must be provided with all the material required for its maintenance and for the production of a large number of eggs, whether this be secured from the natural food or from the artificial feeding stuffs. Further, during the greater part of the year, there is not the same necessity for anything except grain, and the question of balance in rations does not apply.

Feeding Semi-Intensively and Intensively Kept Birds.—When

laying fowls are kept in confinement—the provision of a small grass run does not provide adequately natural food—extreme care must be taken to supply all necessary ingredients. That is, the deficiencies in the artificial foods must be made good.

The chief need under these conditions is to ensure that the fowls are obtaining vitamins A and D adequately. A regular supply of fresh greens, such as lettuce, kale, cabbage, sprouted oats and sprouted barley, will generally provide all the vitamin A required. The quantity consumed may be left to the fowls' instincts. When fresh greens cannot be secured, and it is not convenient to sprout oats or barley, vitamin A may be supplied in dried alfalfa or dried clover. Failing all these a source of supply is cod liver oil. When this is used it is important to see that a tested oil only is purchased, since the vitamin is generally destroyed—vitamin A is a very unstable compound—in a low grade sample. Cod liver oil is also valuable in that it contains iodine, but the fact that it is deficient in mineral salts implies that it should only be employed as a source of vitamin A when other substances cannot be obtained. It is, therefore, only recommended as a temporary vitamin A supplement. Vitamin D is also contained in cod liver oil; therefore, when both vitamin A and vitamin D are deficient it may well be used as a supplementary food. When fresh greens are available in sufficient quantity, and it is known that vitamin D is lacking, it may be made good by the use of a low grade cod liver oil, since it is more stable than vitamin A. The correct quantity to use in both cases is 0·5 per cent; that is, 1 part of oil to 200 parts of the mash ingredients. In the continued absence of sunlight during cloudy or foggy weather it has been found advisable to supply vitamin D, since, as explained previously, it takes the place of the ultra-violet rays.

To ensure that confined birds secure adequate supplies of mineral matter a mixture should be added to the mash. Common salt (sodium chloride) stimulates the appetite, aids digestion and is also needed for many body processes, while it is not poisonous, as commonly imagined, when fed in small quantities. From 0·5 per cent to 1 per cent is sufficient. When fish meal and alfalfa or clover are present in the mash, calcium and phosphorous are both supplied. If the fish meal is low in mineral content, 2 per cent of limestone should be added. Where vegetable proteins are chiefly used in the mash it is

advisable to add both limestone and bone meal. A good mixture for this purpose is 40 per cent ground limestone and 60 per cent steamed bone meal, of which 1 lb. should be added to every 5 lb. of meals, as recommended by Holst and Newlon (4). Corrie (15) recommends a rather more elaborate mineral mixture this being composed of feeding bone flour, 50 lb.; finely-ground limestone, 23 lb.; common salt, 20 lb.; sulphur, 5 lb.; oxide of iron, 2 lb.; and potassium iodine, about 4 ozs. Of this he advises the use of from 3 per cent to 4 per cent for laying stock.

Milk, in all its forms. This is an excellent food for poultry. It is a valuable adjunct to feeding, but only when it can be secured at a reasonable price. Milk does not possess any special advantage, and, therefore, must be considered in relation to its digestible nutrient value alone. From this point of view whole milk is too expensive to warrant its use. It is also questionable, whether it pays to feed semi-solid, dried, or fresh skim milk to all classes of poultry. It is a mild stimulant. As such may well be used for pullets in the autumn to encourage laying, or for hens in the late summer as these are going out of production, provided their body weight is still maintained. There does not appear to be any difference in the value of the three forms of skim milk. It may be taken that 10 lb. of fresh skim equals 3½ lb. of the semi-solid variety, and 1 lb. of the dried sample. Skim milk may be supplied either in a sour or a fresh state. It does not signify to any extent which is fed, provided one or the other is given all the time. The lactic acid, however, in the sour skim is valuable when this food is supplied as a preventive or a cure for coccidiosis. Skim milk is sufficiently reasonable in price to permit of its use for chickens. Judging by the results which accrue it has been found extremely useful for chickens from one-day old to three months, for which purpose it is strongly recommended. In that case the skim milk is better in liquid form giving this in place of drinking water. Practically all the nutrients of skim milk are digestible. The analysis in its liquid state and diluted as suggested is as follows:

Water per cent	Proteins per cent	Carbohydrates per cent	Fat per cent
90·0	3·0	5·6	0·6

Grit.—This should be provided at all times, except where the

birds are on full range. Hard grit, such as granite serving the purpose better than soft grit, such as limestone. It is essential to enable the food to be ground in the gizzard. Hard grit does not take the place of mineral matter, since it is not soluble.

Charcoal.—At one time doctors held the belief that charcoal was a valuable substance for absorbing the gases given off in the digestive tract and thus reducing the risk of digestive complaints. Present opinion is, however, in the direction that charcoal has been over-rated and that it is of questionable value, but the writer does not believe this to be correct. He contends that granulated charcoal should be kept before all birds at all times.

Condiments.—Provided the birds be fed in a proper manner condiments should not be necessary. They are of a stimulating nature and, therefore, require careful usage. A little mustard may be used on occasions in very severe or inclement weather, but when necessary reflects upon the feeding system indicating that it is not all it should be.

Nutritive Ratio for Layers.—The nutritive ratio of the total food must depend, to a great extent, upon the condition of the birds. Practical experience indicates that a ratio of from 1 to 4·5 to 1 to 5 gives the most satisfactory results. The grain ration fed generally has a broad ratio, say about 1 to 6·7. The mash contains more proteins and usually has a ratio of about 1 to 3·5. When equal quantities of the two are fed the ratio of the combined foods is slightly under 1 to 5.

The condition of birds is the best guide. If it be found by handling when the birds are laying heavily that they are losing weight, it naturally suggests that rather more grain should be fed, so that the ratio is broadened ; this results in a slight drop in production. As the birds are enabled to gain weight they come into condition again, and, moreover, their power of resistance is increased. On the other hand, if the birds are laying poorly and becoming fat and lazy, it implies that less grain and more mash should be supplied, so that the egg organs are stimulated. The feeding of a too narrow ratio may well be one of the chief causes of heavy laying pullets falling into a partial moult in the winter ; this can be obviated by increasing the proportion of grain supplied.

Rations.—The question is frequently asked, " What is the best ration for laying hens ? " It can be stated definitely that there is no

such thing as a "best ration," since any ration which provides the proper kinds and proportions of nutrients as cheaply as possible is a good one. Any claims made that such-and-such a mixture is the acme of perfection should be discredited. Two or three rations, taken from different sources, are given below, but these are not mentioned because they are the best, but because they have given excellent results in a large number of instances. They are detailed here purely and simply as a guide; more is not required, since the local cost of the various feeding stuffs must always remain the deciding factor.

Feeding Laying Stock.—A mash that has given remarkably good results in Great Britain is that suggested by Newman (20) and is as follows:—

Grain	Mash		
Equal parts of wheat and kibbled maize	Middlings	6	parts by weight
	Bran	2	,,
	Maize meal	4	,,
	Sussex ground oats	2	,,
	Fish meal	2	,,

From the same source two other layers' mashes and grain mixtures may be taken, these being as follows:

Grain	Mash
Wheat, 3 parts by weight	Middlings 42 lb.
Kibbled maize, 1 part	Potatoes or Rice (cooked) 28 lb.
Oats, 1 part	Malt culms, 7 lb.
	Bran, 7 lb.
	Fish meal or meat and bone meal, 14 lb.

and

Grain	Mash
As above	Middlings, 42 lb.
	Maize flakes or Biscuit meal, 21 lb.
	Bran, 14 lb.
	Soybean meal, 10½ lb.
	Fish meal, 10½ lb.

A mash formula which employs dried milk as the sole course of animal food, and one which has given excellent results during the

past three years can be compounded as follows :

Middlings, $4\frac{1}{2}$ lb.
Bran, 2 lb.
Sussex ground oats, 1 lb.
Maize meal, 1 lb.
Dried yeast, $\frac{1}{2}$ lb.
Soybean meal $\frac{1}{2}$ lb.
Dried milk $\frac{1}{2}$ lb.

In the opinion of the writer these should be augmented by a vitamin A supplement and Corrie's mineral mixture. It is at times necessary to feed laying birds upon rations containing practically no other than vegetable proteins. When this has to be done the following, as suggested by Holst and Newlon (4), will be found to give highly productive results :

Grain	Mash	
Corn, or milo, 116 lb.	Corn or milo, 80 lb.	Ground together
Wheat or kafir, 116 lb.	Wheat or kafir, 80 lb.	
Barley or Oats, 116 lb.	Barley or Oats, 80 lb.	
	Fish or meat meal 15 lb.	
	Soybean meal 75 lb. (or peanut meal.)	
	Mineral mixture, 17 lb.	
	Finely ground salt, $1\frac{3}{4}$ lb.	

Vitamin A supplement and calcium in any form—preferably as Corrie's mixture, should be provided separately.

Dougherty (21) has compounded a ration that has found great favour with many poultry keepers. This is as follows :

Grain	Mash	
50 lb. yellow corn	50 lb. wheat	all ground and mixed together
50 lb. barley	25 lb. yellow corn or milo	
	25 lb. barley or oats	
	Milk kept before the birds all the time and also used for moistening the mash.	

Vitamin A supplement and minerals should be provided separately.

Another ration that has proved successful is that suggested by Brown (22) and is as follows :

Grain		Mash	
Wheat or dari	1 part by weight	Maize meal	3 parts by weight
Barley	1 part by weight	Bean meal	1 ,,
		Barley meal	3 ,,
		Bran	2 ,,
		Clover meal	1 ,,
		Meat meal	$\frac{3}{8}$,,

Vitamin A supplement and minerals should be provided separately.

Feeding Breeding Stock.—It is not advisable to allow the breeding birds to lay so heavily as the layers, since this tends to increase infertility, bad hatching and mortality in the chicks. It is necessary, therefore, to decrease the proportion of protein in the food. This can be accomplished by cutting down the animal food by one-quarter and at the same time supplying vitamin A and vitamin D supplements together with Corrie's mineral mixture.

As an example of an eminently satisfactory breeders' ration that suggested by Newman (20) may be cited. This is as follows :

Grain		Mash	
Wheat	3 parts by weight	Middlings	8 parts by weight
Oats	1 ,,	Maize meal or maize germ	2 ,,
Maize	1 ,,	Sussex ground oats or biscuit meal	2 ,,
		Bran	1 ,,
		Alfalfa or Clover	1 ,,
		Fish meal	2 ,,

Vitamin A and vitamin D supplements (greens and cod liver oil), and minerals should be added.

Quantity of Feed to Feed.—The quantity of food supplied to layers must be governed entirely by their condition. As a guide it is suggested that the light breeds, such as Leghorns, Anconas, etc., require about $3\frac{1}{4}$ oz. per diem and the heavy breeds, such as Wyandottes, Rocks, Rhode Island Reds, etc., $3\frac{3}{4}$ oz. per day, when kept intensively.

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CHAPTER XXV

FORMATION OF THE EGG AND CHICKEN.

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FORMATION OF THE EGG AND CHICKEN.*

WONDERS OF AN EGG—HOW AN EGG IS FORMED—PROCESS OF PRODUCTION—FORMATION OF THE CHICKEN—INFLUENCE OF THE YOLK—FIRST DAY OF DEVELOPMENT—SECOND DAY—THIRD DAY—FOURTH DAY—FIFTH AND LATER DAYS—PROCESS OF HATCHING.

Though a common article of food an egg is one of the wonders of Mother Nature. It has been described as 'a sermon and a miracle.' It consists of 'a mass which forms in the ovaries and oviducts of a large number of animals, and which in a common envelope encloses the germ of the future animal, with the liquids destined to nourish it during a certain lapse of time, when the vital impulse has been communicated to it by fecundation and incubation.' The object in production of an egg is to envelope the germ. Impregnation of an egg, however, does not appear to have an influence upon the actual formation. A hen will lay when her oviary becomes active independently of her being mated with a male bird. Hundreds of millions of eggs are laid every year which could never hatch by reason of the fact that these have not been fecundated. The old notion that mating is necessary to or stimulative of egg formation has now been abandoned.

How an Egg is Formed.—An egg has two diameters, one of length and the other of breadth, a small end and a larger one. Eggs from the wild or naturally kept fowls when domesticated are small, about 1½ ounces or less. Selective breeding and liberal feeding have increased the size, though eggs vary considerably according to the breed and age of the hen. The market demands eggs not less than 2 ounces, or eight to the pound, and the tendency is to a higher standard. The outer envelope or shell is white or tinted or brown according to the race or breed. Increase of number of eggs laid by an individual hen is generally accompanied by loss of shell tint or colour when that is present. The

*Plates LXXX to LXXXII.

shell is composed of carbonate of lime, phosphate of lime, and animal gluten. Salts of lime hardens the shell, causing the particles to adhere. Soft eggs are those which have no shell. Others may have a very thin shell, owing to deficiency in salts of lime. Hence the essential importance of lime in the food supply. If a hen lays 100 ordinary-sized eggs during the year, she will have produced about 22 ounces of almost pure carbonate of lime. Thus, as Mr. P. L. Simmonds, F.L.S., observes (1) if a farmer has a flock of 100 hens, these will produce about 137 pounds of chalk annually, and yet not a pound of that substance, perhaps not an ounce, may be found on the farm in a pure state. The materials are contained in the food consumed, and in sand, pebbles, brick-dust, pieces of bone, etc., which hens and other birds are constantly picking up. Their instinct is keen for these apparently innutritious and refractory substances, which are devoured with eagerness. Where hens are confined within buildings, it is obvious that the egg-producing machinery will fail in action, unless materials for the shell are supplied in other ways. Should these be confined in a shed, and fed with almost any of the cereal grains, excluding all sand, dust, grit, or earthy matter, they will lay eggs for a time with fully formed shells. Vauquelin, the distinguished chemist, confined a hen for ten days, feeding her exclusively upon oats, in which there is very little carbonate of lime. During the time named she consumed 7,474 grains in weight, and laid four eggs, the shells of which weighed 409 grains. Of that amount 276 grains was carbonate of lime, 17½ phosphate of lime, and 10 gluten. It is more than probable there was some reserve stock of shell-forming substances in her body ere she was shut up, and that had the experiment been continued shell-less eggs would have been laid.

The shell is porous, or permeable by the air, without which the chick could not live during the process of incubation. The fragile outer covering is not the compact envelope its appearance would indicate, for it is perforated with a multitude of minute holes or pores. When examined under the miscroscope, the shell has a sieve-like appearance, resembling the white perforated paper sold by stationers. By means of these perforations there is a constant evaporation going on from the time an egg is laid, depending upon the conditions under which it is kept, much more rapid in warm weather than in cool, and under warm conditions. For that reason eggs deteriorate more rapidly in

summer than in winter. If this evaporating process is checked or prevented, and no other influence of an antagonistic nature be brought into operation, the egg remains sound for a considerable length of time. The substance used to close the pores of the egg must not be soluble in watery fluids, or liable to be readily removed. By means of chemical agencies the minute holes in the shells of eggs can be closed or filled with lime placed in contact in solution, and the contents preserved sweet and good for months. That may apply for human food. It does not for reproduction.

Within the shell are two membranes or skins, the outer one of which adheres to the shell, and the inner one slightly to the outer. Towards the larger end of the egg the two separate, forming the air chamber. The white of an egg partly consists of albumin, and is a transparent liquid, tasteless and free from smell when fresh. The albumin coagulates on the application of heat at 140° F., and is insoluble in water. Chemical analysis demonstrates that it is composed of carbon, oxygen, hydrogen, azote, phosphorous, and sulphur, in various proportions. A part of the oxygen and hydrogen evaporates during incubation, or when the egg becomes stale by age. In the white are three distinct and separate layers of albumin; the outer (most liquid), the second in which the chalaze terminate, and the inner. The chalaze are two twisted cords of a more dense albuminous character, which have their origin in the outer albuminous layer, taking the form of a spiral cord in the direction of the longer axis of the egg. These are well known to all eaters of eggs, and are the portion removed by cooks when beating. They form a ligament by means of which the yolk remains suspended in the midst of the albumin, with the germ floating on top, and encircled by the thin membrane known as the membrane of chalaze.

The yolk is the principal portion of an egg. It is separated from the white by a very thin enveloping membrane, called the vitelline membrane, and floats high when the egg is lying on its side. The yolk furnishes nourishment to the embryo, and is richer in composition than the albumin. In it is comprised a layer of white yolk, which does not harden even by cooking. Within this are concentric layers of yellow and white, which curve round the utricle, the interior of which contains the germinative vesicle. When the egg is perfectly formed the vesicle

touches the vitelline membrane, at the upper part of which is found the germ, known as a yellowish-white circle. The yolk is composed of albuminous matter, of organic salts, of vitelline, of colouring matter (a red and a yellow) of phosphoric acid, and of a fatty phosphoric substance. It is of itself sufficient to support the chick during its earlier stages of growth within and after emergence from the shell.

Process of Production.—The ovum, or yolk, containing the germ, is generated in the ovary, expands gradually, and when ripe there is a rupture of the ligament by which it is attached. Passing down the oviduct, if fertilised it is impregnated by the male element, coated with layers of albumin, has the chalaze attached in their proper position, and finally receives the membranes and outer shell. The delicate organism is easily thrown out of gear.

Eggs are formed from what may be regarded as surplus food, by which is meant that not absolutely required for sustenance of the hen. Inadequate supply checks production. Should food be given in excess or of too stimulating a nature, the result, in the one case, is that the organs are congested with fat, and the process hindered, or, in the other, the ovules are produced with too great rapidity. In the ordinary course, when in full operation, only one ovum is discharged in twenty-four hours, and fowls do not lay every day. Where two ovules are produced in one day, many eccentricities are the result. Sometimes two of these pass into the oviduct together, when a double-yolked egg is formed. Generally these do not hatch, or may result in monstrosities. Occasionally it has been known that two perfect chicks are developed and hatched out of one shell. Another result of overfeeding is the production of one perfect egg within another. This is caused by an irritation of the oviduct, which, contracting in front of the egg already formed, instead of behind it, checks or forces it back where it meets another yolk, and, the two are coated with white and shell. Soft eggs result from fattening food and too little exercise, the ovum passing down the oviduct too rapidly for the secretions to be applied, or, on the other hand, may be caused by deficiency of shell-forming material. These irregularities are not found in wild birds, and are a penalty of domestication.

The variation in size of eggs already referred to is not relative to the size of the parent stock. Some of the larger breeds produce com-

paratively small eggs, and *vice versa*. Where selection for size of egg is adopted this result can be attained. Disregard in this direction by concentration of selection to characters or to number of eggs, as in some breeds, speedily leads to loss of egg size as evidenced in several races of fowls.

Formation of the Chicken.—Given the presence of a living germ within a shell, if proper heat and moisture are applied, with regular cooling and turning, the process of development follows the natural course, resulting in the appearance of a chicken at the end of the normal period, usually twenty-one days. As the germ vesicle during the earlier stages requires that the heat shall be direct, a delicate and beautiful arrangement is that of the chalaze, which keep the yolk in that position by weighing down the lower side of it. However the egg may be turned the germ floats at the top. When a hen is engaged in brooding the eggs she turns her eggs constantly. In an incubator this example must be followed though to a lesser degree, or there will be an adherence of yolk and white with death of the embryo.

In the case of a fertile egg when heat is applied the germ commences to expand, and within twenty-four hours has sensibly enlarged. The heat should be adequate and regular. So far as known 100° F. in the egg chamber above the eggs is too low for hatching. The germ will commence the process but fail to complete. Over 106° F. in the egg chamber would appear excessive, possibly killing the embryo by too rapid development.

Fertile and Infertile Eggs.—In this respect by fertile is meant that the germ vesicle in the egg includes both male and female elements, namely, that there is life. That is the case whether it hatches a chicken or not. In many instances there is lack of elements to supply what is needed by the embryo. The term infertile indicates that, however perfect in all other respect there has been no male impregnation. There is not life, and a total absence of hatchability. The effect of heat upon an egg is to dry up and reduce the contents to a smaller compass. It should be explained that an infertile egg does not as a rule become decomposed. There cannot be death unless there has been life, and death leads to decay. The exception to this rule is when an egg has been laid by a hen that is diseased. Absence of a fertilised germ, with that exception, means the contents are inert. Where there has been

life, and this has died from any cause, the elements of decomposition are present. The term addled is used to denote an egg in which the embryo has developed for a few days and then died. Dead-in-shell usually indicates death during later stages when the body formation is fairly complete.

Influence of the Yolk.—With respect to function of the yolk in development of the embryo, Marshall (2) says: 'The embryonic portion is formed from the part of the egg comparatively free from food-yolk, and becomes converted directly into the embryo, while the vitelline portion or yolk-sac, which contains the bulk of the food yolk, does not give rise directly to any part of the embryo, but forms a store of nutriment at the expense of which the development of the embryo is effected. At first the embryonic portion is very much smaller than the vitelline portion or yolk-sac, but inasmuch as the embryo grows by absorption of the food-yolk, the yolk-sac diminishes as the embryo increases in size. A time comes when the two are about equal in bulk, and in the later days of incubation the yolk-sac is much smaller than the embryo. By the twenty-first day of incubation the yolk-sac is almost completely absorbed.'

¶ What is called segmentation has taken place when a fertile egg is laid by the hen. This is in effect a commencement of development of the embryo, resultant from heat of the hen's body during the passage down the oviduct. A minute cap is thus formed over the germ vesicle, on the under side of which is a number of cells. These have no form indicative of their later use, but are very distinct, and under the microscope reveal various characters. After the egg is laid the process is suspended, resuming when heat is applied by hen or incubator.

First Day of Development.—Those parts of the embryo which afterwards form some of the leading organs of the body, notably the head, the vitelline vein, and neural fold and groove, are developed during the first twenty-four hours of incubation. At this stage it is not easy to distinguish between the embryo itself and the surrounding part, known as the area pellucida. At this stage is formed the amnion. This is a peculiar membrane enveloping the embryo, and forming a cavity in which it lies. It is made in folds, and 'when the several folds meet and coalesce above the embryo, they unite in such a way that all the inner limbs go to form a continuous inner membrane or sac. The inner

PLATE LXXX

APPEARANCE OF EGGS THROUGH SHELL

(Photos Mr. Chas. S. E. Hearson, by courtesy of Spratts Patent Ltd.)

New-laid Egg showing air space.
Fertile Egg, Fourteenth Day.

Fertile Egg, Eighth Day.
Infertile Egg with broken yolk, Fourteenth Day.

membrane thus built up forms a completely closed sac round the body of the embryo, and is called the amniotic sac, or amnion proper, and the fluid which it afterwards contains is called the amniotic fluid, or *liquor amnii*. . . . The outer sac over the embryo lies close under the vitelline membrane, while its periphery is gradually extended over the yolk as the somatopleuric investment of the yolk-sac. It constitutes the false amnion, while the membrane of which it forms a part is frequently known as the *serous membrane*.' (3).

Second Day.*—The sections of the embryo now begin to assume a more definite form, and various organs to indicate something of their ultimate shape. The head becomes more prominent, growing more rapidly than the remainder of the body. During the earlier stages there is no relation in size between head and rest of the body, as is the case later and after hatching. The embryo has considerably enlarged though still very small. Up to this stage the head is straight, and not till later does it assume the final shape.

At the beginning of the second day the front end of the neural canal dilates into a small bulb, whose cavity remains continuous with the rest of the canal. This bulb is known as the first cerebral vesicle, making its appearance in the early hours of the second day. From its sides the two optic vesicles grow. Behind the first cerebral vesicle two others make their appearance very shortly after the first, and still farther back two shallow pits are to be seen, the auditory pits constituting the initial stages of the organ of hearing.

The heart is at first formed within the head fold, where the throat will afterwards be found, though that organ has not yet appeared. The heart begins to beat, at first slowly and infrequently, soon assuming more frequent pulsations. Connected with it are the veins, which are more fully dealt with in connection with the vascular system. During the latter half of the second day the blood begins to circulate.

With reference to the head and brain (3) ' at the beginning of this (second) day the front end of the medullary canal was dilated into a bulb, the first cerebral vesicle, which by budding off two lateral vesicles become converted into three vesicles; a median one connected by short hollow stalks into a lateral one on either side. The lateral vesicles, known as the optical vesicles, have become converted into parts of the eyes; the median one still retains the name of the first

*Plates LXXX to LXXXII.

cerebral vesicle.' On examination, wrinkles are discerned in the head, which 'vary a good deal in appearance, and shift from time to time, but eventually, before the close of the second day, after the formation of the optic vesicles, settle down into two constructions, one separating the first cerebral vesicle from that part of the medullary canal which is immediately behind it, and the other separating the second portion from the third. So that instead of there being one cerebral vesicle only, as at the commencement of the second day, there is now, in addition to the optic vesicles, a series of three, one behind the other; a second and third cerebral vesicle have been added to the first.' Towards the end of the second day the fore brain, with its optic and cerebral vesicles, becomes slightly bent downwards, so as to form a rounded obtuse angle with the rest of the embryo. This is the head fold, about which more will have to be said.

During the second day is found the first trace of the allantois, a temporary arrangement with most important functions during the period an embryo is within the shell, and assuming a more prominent form during the third day. It is part of the alimentary tract with which it opens immediately in front of the gut. 'At first it is enclosed within the hind-gut, but on the fourth begins to pass out beyond the body of the chick, and eventually spreads out over the whole body. On the first half of the fourth day the vesicle is still very small, and its growth is not very rapid. Its mesoblast wall still remains very thick. In the latter half of the day its growth becomes very rapid, and it forms a very conspicuous object in a chick of that date. At the same time its blood vessels become important. It receives its supply of blood from two branches of the aorta, known as the allantoic arteries, and the blood is brought back from it by two allantoic veins, which run along in the body walls, and, after uniting into a single trunk, fall into the vitelline vein close behind the liver.' (3) By the ninth day the allantois has grown largely, and has spread over the back of the embryo, and quite halfway round the interior of the egg shell. It lies close to the shell, and is the medium through which the respiration of the embryo is affected. On the twentieth day the allantois dries and shrivels up, and as the chick steps out into the outer world it is cast off.

Third Day.*—This is recognised as the most important of all, in that so many new organs begin to make their appearance. 'On

*Plates LXXX to LXXXII.

EMBRYONIC DEVELOPMENT OF THE CHICKEN.

(Photographed from Nature by Mr. Chas. E. Hearson, by courtesy of Spratts Patent Ltd., London)

Embryo after 24 hours' incubation.
Embryo Fourth Day.

Embryo after 36 hours' incubation.
Embryo Fourth Day from above.

opening an egg on the third day, the first thing which attracts notice is the diminution of the white of the egg. This seems to be one of the consequences of the functional activity of the newly-established vascular area, whose blood vessels are engaged either in directly absorbing the white, or, as is more probable, in absorbing the yolk, which is in turn replenished at the expense of the white. The absorption, once begun, goes on actively so that by the end of the day, the decrease of the white is very striking.' (3)

As already indicated, during the second day of development, there is a commencement of the head-fold, which change proceeds rapidly during the third day, by the end of which it is entirely folded over, the optic vesicles in the centre on either side. At first these are comparatively small, steadily increasing in size, and finally assuming the prominence and position to be retained throughout life. The shape of the head is modified later, as the brain-pan has to be filled, the beak and mouth to be formed, although the nostrils and ears by this time are well established. The head is really the first part of the body to assume a definite shape, and is then disproportionately large to the rest of the body. The formation of the eye is one of those wonderful processes general in natural development, in which the needs of the future animal are provided for by a multitude of marvellous growths and evolutions.

The nostril, or organ of smell, appears during the third day, at first being two depressions in the under-surface of the head, immediately in front of the eyes. During the same period the alimentary canal forms with great rapidity, which is to some extent connected with the tail fold, in itself very similar to the head-fold, so far as the method of formation is concerned. This is the initial stages of the digestive system. Lungs, liver, and kidneys commence to grow, although at first very diminutive. From the first the nerves exert a very important influence in the bird's structure.

Fourth Day.*—Rapid progress is now taking place, and increase of size in the embryo becomes very manifest. The white of the egg has diminished to a greater extent. The embryo is lying almost in immediate contact with the shell. The vascular area by this time is nearly an inch in diameter, and there is a great increase in the quantity of blood circulating through the veins. The head and other parts are

*Plates LXXX to LXXXII.

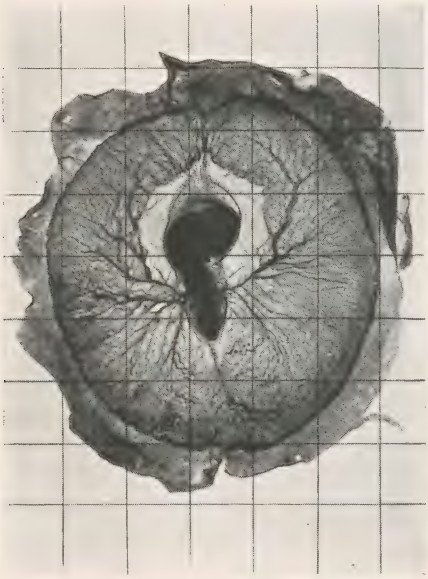
quickly assuming a definite form. The most striking feature to be noted is the growth of the body proper, from which the limbs begin to spring on the fourth day, though these can be slightly traced towards the end of the third day. At first these are simply conical buds projecting outwards, covered with a sort of cap. The front limbs (wings) are longer and narrower than the hind-limbs (legs), which are comparatively short and broad. The vertebral column now takes more definite form, though not until the fifth day is it complete. Towards the end of the fourth day is formed in the embryos a duct, which in the female forms the oviduct, but as it is not required in the male it disappears.

During the fourth day the generative organs make their appearance, as yet indistinctly. Not until a later period are their distinctive appearances determined. At first these seem to be identical, usually termed primordinal ovum, the first traces of the male organ being discernible on the sixth day. What are the influences which determine the sex are unknown. All theories are speculative.

Fifth and Later Days.*—By the fifth day 'the limbs have increased, especially in length; in each a distinction is now apparent between the more cylindrical stalk and the flattened terminal expansion; and the several cartilaginous precursors of the several bones have already become visible. The fore and hind limbs are still exceedingly alike, and in both the stalk is already beginning to be bent about the middle to form the elbow and knee respectively. The angles of both knee and elbow are in the first instance alike directed outwards and somewhat backwards. By the eighth day the elbow has come directly backwards and the knee forwards. In consequence of this change the digits of the fore-limb point directly forwards, those of the hind-limb directly backwards. This state of things is altered by a subsequent rotation of the hand and foot on the arm and leg, so that by the tenth day the toes are directed straight forwards, and the digits of the wings backwards and somewhat ventralwards, the elbow and knee almost touching each other . . . By the tenth day the fore and hind extremities, save for the absence of feathers and nails, are already veritable wings and feet.' (3)

The development of the chicken from the sixth day to its appearance from the shell does not require description, as it is to a large

*Plate LXXXII.



EMBRYONIC DEVELOPMENT OF THE CHICKEN

(Photos Mr. Chas. E. Hearson, by courtesy of Spratts Patent Ltd.)

Showing embryo after 48 hours' incubation *in situ*. Embryo Fifth Day.

Embryo after 72 hours' incubation. Fully-developed Chick in Shell.

extent growth of the various parts and organs. There are, however, some features which are of very great interest.

The fact that embryos are so much alike in the earlier stages is a proof of the theory of evolution. Striking and numerous as are the features which render the class Aves one of the most easily recognisable in the entire animal kingdom, the embryo of a bird does not materially differ from that of a reptile or a mammal, even to the points of structure which are distinctly avian. It is possible, even at a comparatively early stage to infer from subsidiary tokens, whether an embryo belongs to this class or that (and, indeed, the same inference may be drawn from the ovum itself). Up to a certain stage, however, it is impossible to point out in the embryo of a fowl the presence of feathers, which may be taken as broadly characteristic of an avian organisation. The absence of any distinctive differentiation lasts in the chick, roughly speaking, till the commencement of the sixth day. We do not mean by this that on the sixth day all the organs suddenly commence to exhibit peculiarities which mark them as avian.*

There are no strongly marked breaks in the history of development; its course is gradual, one stage passing continuously into the next. The sixth and seventh days, however, mark the commencement of the period in which the specialization of the bird begins to be apparent. For the first time lighter-shaded lines below indicate all that is left of the white. By this time the body walls are definitely formed, and rudiments of the feathers are already present. 'The head is still disproportionately large, and the eyes are of enormous size. The beak, which was absent in the earlier stages, has now grown out from the front of the face, and at once gives the bird a distinctly avian appearance. The neck is long and slender. The body is much more bulky than before, owing to the great size of the heart and liver. The limbs have greatly increased in length, their several segments are well established, and the division of the distal ends into fingers and toes is very evident. The white of the egg has disappeared, a thick and very viscid mass alone remaining at the lower surface of the egg. The yolk-sac is still large, but its walls are flabby owing to the absorption of a large part of its contents as food by the embryo.' (2)

From this time onwards the principal business of the chick, as it may now be termed, is to grow. The feathers begin to appear on the

*Plate LXXXIII.

ninth day. Then the sacs in which they are contained commence to force their way through the skin, and by the thirteenth day these are found all over the body, to the length of a quarter of an inch, and can be recognised as feathers. These, however, remain in the sacs until hatching, when these sheaths burst and are thrown off.

On the eighth day the beak has begun to show itself, first as a chalky-looking mass, which by the twelfth day has developed into a horny beak, though still soft. It is not until the thirteenth day the nails take their form, and by the sixteenth day these, together with the beak, harden considerably.

About the sixth day movements can be discerned in the embryo, comparatively slight until the fourteenth day, for it retains the same position all the time—namely, the body is at right angles to the long axis of the egg. At the period named a definite change of position is to be noted, for the bird now moves so that it lies lengthwise in the shell, its beak touching the inner shell membrane, the air-space at the broad end having greatly increased in size. This is the position a chick must occupy in order to make its way out of the shell, for if not so placed there will be a false presentation, and, probably, inability on the part of the chick to make its way out.

By the twentieth day the chick has grown so as to fill all the shell except the air-space. The position is very beautifully shown in Plate LXXXII., from which the shell and membrane have been removed. By this time the yolk has been almost entirely absorbed, and what remains in the sac is drawn into the body, the walls closing over it at the umbilicus. The yolk contains enough food to supply the chick for three days after hatching. Nature always provides for the first separate nutrition of its creatures.

Process of Hatching.—When ready for the final stage the chick has only to lift its head and pierce the inner shell membrane, which it easily accomplishes under normal conditions, when it commences to breathe the air contained in the chamber. The doing so causes the pulmonary circulation (breathing) to become functionally active, and the blood ceases to flow through the umbilical arteries. As a result the allantois shrivels up, its purpose having been served. The head is lifted into the air-chamber, and the chick has now room to deal blows upon the shell, which repeated upon the same place result in fracture

of the shell. Turning round a little, this process is repeated, and so on until the shell is broken round about one-third from the broad end. When completed, by pressing its head against the broad end and its feet against the other portion, it is enabled to throw off the shell, and it emerges into the world.

Though the process of development may be described, the mystery of life itself, as of the influences which bring about the divergences of type, in some cases of structure, in our poultry, are still the secrets of Nature, which seems to say, and in no hesitating manner, "Thus far shalt thou go, and no farther." We may speculate in this direction. Of knowledge there is comparatively little.

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CHAPTER XXVI

HATCHING—NATURAL AND ARTIFICIAL.

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HATCHING—NATURAL AND ARTIFICIAL.

ELEMENTS IN HATCHING—PLACES FOR SITTERS—HATCHING ROOMS—FEEDING THE HENS—COOLING AND FEEDING—HATCHING BY TURKEYS—MAKING THE NEST—CHOICE OF EGGS FOR HATCHING—REGISTER OF HATCHING—TESTING THE EGGS—INCUBATORS AND THEIR USE—ARE INCUBATORS PRACTICAL ?—LIMITATIONS OF ARTIFICIAL INCUBATION—INCUBATOR HOUSES—TYPES OF MACHINES—TANK INCUBATORS—HOT-AIR INCUBATORS—MAMMOTH INCUBATORS—MANAGEMENT OF INCUBATORS—MOISTURE—GENERAL HINTS.

Reproduction involves, in the case of birds, the production of eggs containing the living germ and the materials requisite for embryonic development. When an egg has been laid there must follow the more or less mechanical process known as incubation, together with suitable environment, as a result of which the germ enlarges into the embryo, forming, stage by stage, the various parts and ultimately the complete chicken, to the point when it emerges from the shell. From what has been stated in the previous chapter this process is complex in the extreme. We have to take into account pre-natal influences in all their diversity, equally as to the quality and vigour of the parents, the conditions under which eggs are produced, and how far the system adopted in hatching conforms to the requirements of the embryo. Nature if left to herself seldom fails. It is where her methods are changed that difficulties arise. It is with the process under domestication that we are now concerned.

Elements in Hatching.—Heat, moisture, and oxygen are the chief factors concerned in the hatching of poultry. Heat is applied by the hen which, instinctively, knows what is necessary. Moisture is beyond her control if the place for her nest is allotted to her. Naturally she selects a place where the earth contains moisture to a sufficient

degree. In some countries and districts the atmosphere is very dry. Under domestication and control it is of importance to counteract this condition. Seasons also differ. A dry spring will require attention to the question of moisture that would not be necessary otherwise. An adequate supply of oxygen will depend upon whether the air surrounding eggs undergoing the process of hatching is pure and regularly renewed. It is evident, however, that there is much to be yet discovered as to the changes which take place in hatching. Another influence is most important, namely, the effect during prevalence of winds upon hatching. In Europe the biting east winds blowing from the Steppes of Russia have considerable effect upon hatching, why is not known. As a rule under those conditions eggs are less fertile, fertile eggs often become what is known as addled, i.e., the germ or embryo dies, and hens frequently desert their nests, unless they are in places much more comfortable than falls to the lot of human beings. Even there an east wind is very penetrating. We have here an explanation why some seasons are unsatisfactory in results. Our own view is that eggs undergoing hatching under hens are more affected by winds of the nature described than those in incubators. If that is the case it would appear that the body heat of the hen is affected and reacts upon her eggs. In that respect vigour of the germ may determine its power of resistance.

Places for Sitters.—If permitted to do so hens will select a nest when and where they think best. As a rule the percentage and vigour of the progeny indicate that her instinct is a safe guide. Under more intensive conditions she cannot be permitted to do this, and, also, the methods of breeding in many cases induce broodiness at a time of year she will require protection when sitting. Where only two or three batches of eggs are to be hatched during the season, there is not much difficulty in providing for them. A hen can be allowed to nest in a quiet outhouse or shed. If the house or shed can be given up to the hen entirely, it is only necessary to make a nest for her in one corner or use a bottomless box so that it will be on the bare earth. If more than one hen is accommodated in the same place a box for each should be provided, which may have an open or closed front in accordance with the temperament of the hens.

Hatching Rooms.—In spite of the advantages of incubators a

growing tendency has been manifested of late by reversion to natural hatching for the reason that results are generally more satisfactory. Under these conditions the most desirable plan is to devote a well ventilated or roomy shed or house to the purpose, for preference one of the permanent buildings as these are less likely to be affected by variations of temperature. It must, however, be clean and sweet, and not excessively dry. Nor does it require to be too light, and should not be where the general flock can find access. Usually it is preferable to select a house or shed on the ground level.

Under these conditions the plan to be recommended where a considerable number of hens are sitting at the same time, is to cover the floor of the hatching room with ordinary moist earth, on which individual hatching boxes can be placed, with their backs to and about a foot from the walls. Each box should be at least 6 inches from its neighbour, so that there may be a free current of air all around, for reasons already given. In a room 15 feet square sixteen to eighteen of these boxes can be accommodated at one time. The best form of hatching box is about 15 inches square and 18 inches high, constructed of wood with solid back, sides and top, except for ventilation holes on a level with the nest within, in the upper part of the back and sides, and on the top. At the base of the front should be a strip of wood 3 inches in depth, to which is attached a door, solid, or latticed, or a frame on which wire netting is fastened. So hinged it opens downward so that the inmate steps on it when entering or leaving the nest. These hatching boxes are very cheaply made, especially if those in which sugar is supplied to grocers are purchased.

Feeding the Hens.—Under the conditions named it is necessary to make arrangements for feeding the hens, and giving them an opportunity of dusting themselves to cleanse their skin and plumage. For that purpose fine dry earth should be separately provided. If there are only two or three hens they may be allowed to come off when they desire to do so, in which case food, fresh water and a dust bath must be available. With a larger number of hens it is found necessary to let them off in rotation, as otherwise there is considerable risk of quarrelling, and maybe interference with each other's eggs. Hence the necessity for closed boxes as described. To liberate each hen separately would occupy a considerable part of the day. An

excellent arrangement which we first saw operated in France, is to have under a shed outside a row of half a dozen square coops with barred fronts. Each day the hens in rotation are removed from the hatching boxes to the feeding cages, where they are fed and watered. The floors of these cages are thickly covered with very fine dry earth or ashes for the purpose of dusting. If half a dozen are fed at the same time, and each one is removed to the feeding cages in rotation, there is no danger of returning them to the wrong nests. The time is thus greatly minimised. Twenty minutes to half an hour's occupation of the cage is usually enough, and that allows the eggs to be effectively cooled. The old saying that "A close sitter is a bad sitter," is more than justified.

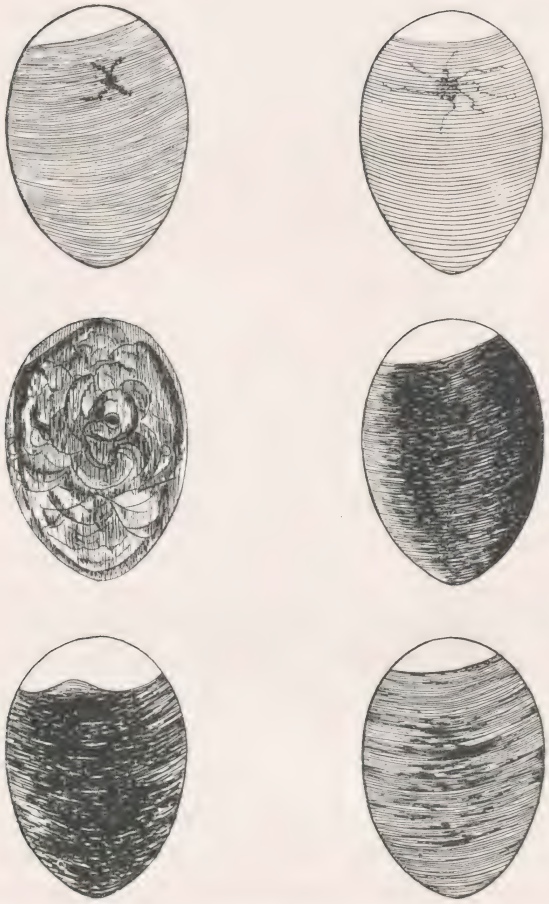
Cooling and Feeding.—Where birds are lifted from the nest they must be carefully handled, as they usually tuck the eggs under their wings, especially when disturbed. Should a hen be lifted bodily, the chances are in favour of an egg dropping and breaking itself and others. She should, therefore, be lifted by the wings, taking care to see that the eggs remain in the nest. Nests should be examined every day. Sometimes an egg is accidentally broken, the contents adhering to her breast and on the remaining shells. Under these circumstances, or in case she fouls the nest, she should be washed and also the eggs, remaking the nest. Hens should not be disturbed more than is necessary.

Sitting hens should not be fed on soft food or wet mash, which tend to loosening of the bowels, but be supplied with hard grain. Fresh water for drinking, and a dust bath are essential.

Hatching by Turkeys.—In some parts of France for generations large numbers of chickens have been hatched by turkeys, and the same plan has been successfully adopted elsewhere. Should a turkey become broody in her first year, when it is undesirable to breed from her, she may be usefully employed as a mother. Not only will she cover twice the number of eggs, and brood three times the number of chickens, than can be given to an ordinary hen, but she is most reliable, is very little affected by the weather, and is ready when called upon at three or four days' notice. Moreover, the male birds can be used in this direction as well as the females.

Making the Nest.—For making the nests within the boxes described above, a shovelful of earth is first placed therein and hollowed into

PLATE LXXXIII *a*



APPEARANCE OF EGGS THROUGH SHELL IN PROCESS OF HATCHING

2nd day	5th day
8th day	11th day
19th day	Infertile or Addled Egg

saucer shape, taking care that the corners are filled, lest any of the eggs roll there and become chilled. Some breeders use damp grass sods beaten into the requisite concave shape. Upon earth or sod, fine straw, oaten for preference, is laid. It is all the better if beaten or rubbed. When completed the nest should be slightly below the level of the cross piece of wood at the front. The eggs must always incline towards the centre of the nest. As a rule when eggs are placed in a hatching box, and the broody hen is set down in front of it, she enters at once of her own accord. Sometimes, however, she is disinclined to do so, probably from the fact that it is strange to her. Where that is the case a desirable plan is to place a few addled or dummy eggs in the nest and shut her in the hatching box. A few hours will show whether she accepts the duty, in which case the eggs to be incubated can be substituted. In that manner many valuable eggs may be saved. It is always desirable to set hens in the evening, as they are usually more amenable at that time of the day, especially after having had a good feed.

Choice of Eggs for Hatching.—Most important is it that there shall be careful selection of eggs for reproductive purposes, in respect to which there is woeful neglect. Given that eggs are obtained from stock which has been mated on definite lines, the eggs themselves require to be carefully chosen. Those which are abnormal in size, whether over or under the average of the breed, or fail in shape, or are malformed, or are weak in shell, should be rejected. What we have to seek for is a strong-shelled, normally shaped egg, slightly above the average in size, in order to counteract the tendency always present, and most of all with highly fecund hens, towards reduction of size. It is undoubtedly true that the size of egg has small correlation with the ultimate size of the chicken which may emerge from it, when fully grown. Many of the breeds which produce large eggs are small bodied, and *vice versa.* At the same time small size of body tends to smaller eggs. Size of eggs sold for consumption is an important factor in the realisable values. If undersized eggs are selected for hatching, we are breeding from the hens which lay these, and transmitting to succeeding generations what becomes an inherent tendency. By selection the size of egg can be materially improved in a few generations, and small eggs be eliminated. This must be done gradually and

with judgment. Eggs which are much larger than the average of the breed are often infertile, and weaker than those which conform to the usual standard. Eggs should also be used as fresh as possible. If held over for a few days, they should be kept in a cool place, and regularly turned.

Register of Hatching.—An excellent plan is to keep a book containing a register of the hatching operations, so that records may be available for reference, both present and future. Each sitting box should have suspended above it a card or sheet, easily seen by the attendant. The following is a simple form for the purpose:

Breed of eggs ... ... _____

Date Set ... ... _____

Date to hatch ... ... _____

Number of eggs ... ... _____

No. fertile on seventh day ... ... _____

Eggs broken ... ... _____

Chickens hatched ... ... _____

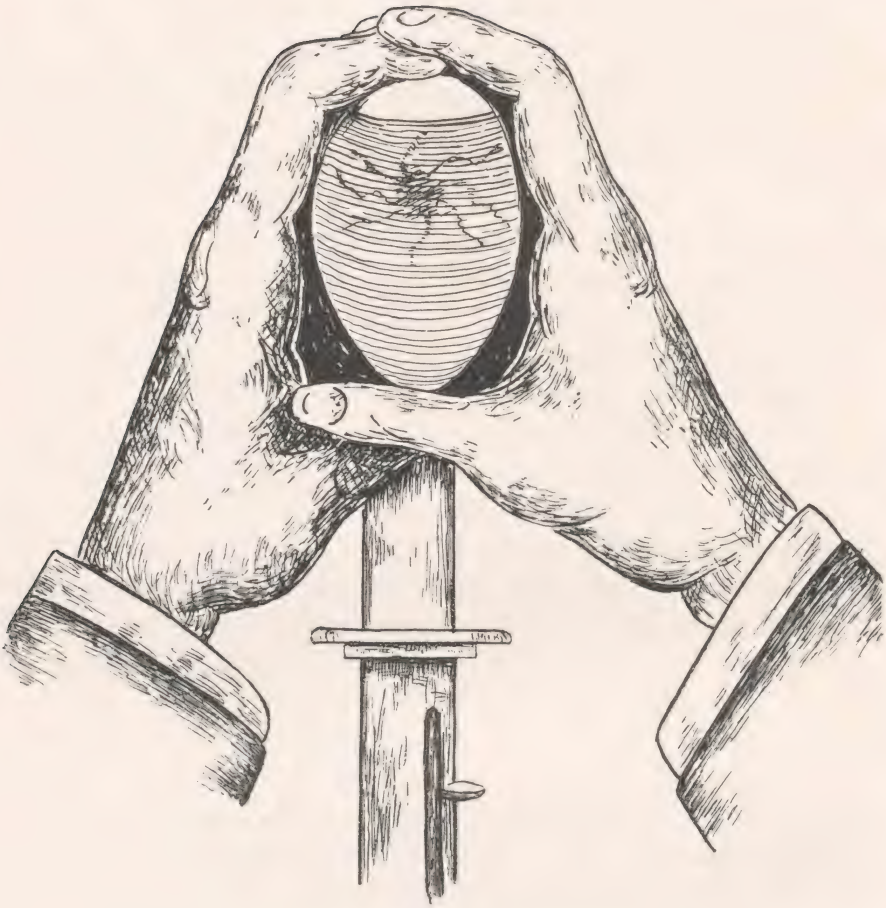
Remarks _____

In addition where breeding is on systematic lines there may be added the Pen or hen No., etc.

Testing the Eggs.*—Formerly when the process was conducted under more natural conditions, and hens were permitted to select their own nests, testing was not general. In these days to do so is economic. Either with hens or incubators, eggs should be tested, preferably about the seventh day, by candle or lamp light. In this way can be discerned how many of the eggs are fertile, so that those which are clear can be removed. From the fact that, as a general rule, these can be used for culinary purposes, in large establishments hundreds of eggs can thus be saved annually, and represent a respectable item in the year's

*Plate LXXXIII.

PLATE LXXXIII *b*



TESTING AN EGG BY CANDLELIGHT

accounts. Further, the space occupied by these eggs can be filled up, and thus the work of hens or machines conserved. For example, if three hens be set at one time—always desirable—and on the first examination it is found that one-third of the eggs are infertile, when these are removed there will be sufficient for two hens, and the third can be given a fresh batch. This test enables a smaller number of hens or incubators to operate to their full capacity.

So far as the method of examination is concerned the first step is to be able to recognise through the shell by the application of light which eggs are fertile, and whether the embryonic process is progressing satisfactorily. At the time stated, say, the seventh day, all eggs should be removed from the nest, either when the hen is feeding or lifting her off for the purpose, and each held in turn between a candle or lamp and the eye. The best time to do this is at night, and a candle or lamp should be placed at a convenient height for the purpose. Then take an egg in the left hand, holding it between the forefinger and the thumb, using the other fingers of the hand to shade the light from the eye. The fingers of the right hand are then placed over the part of the egg-shell left exposed at that side. Thus held the front and back of the shell are bare, and the light illuminates the contents. Black cardboard may be used, cutting in it an oval hole slightly less than the size of an egg. There are also simple and inexpensive egg testers on the market. Powerful lamps can be purchased for this purpose, by means of which the germ can be distinguished at forty-eight to sixty hours after commencement of hatching. Where electric light is available it is only necessary to fit a wide cylinder of blackened tin or cardboard, in which are one or more oval perforations as stated, around the lamp. An infertile egg remains clear or cloudy no matter how long the process is continued. At the end of five days a spider-like form can be discerned; at the end of seven days the central area is darkened. Incubators fitted with rods as bottoms of the drawers, may have an electric lamp passed below, though that is not so reliable.

Incubators and Their Use.—This system has been known for many centuries in Egypt, China, and other countries. In China it is largely used for the hatching of ducklings. This is described as follows (1): 'Each incubator consists of a large earthenware jar having a door cut in one side through which live charcoal may be introduced and the fire

partially smothered under a layer of ashes, this serving as the source of heat. The jar is thoroughly insulated, cased in basket work and provided with a cover. Inside the outer jar rests a second of nearly the same size; as one teacup may in another. Into this is lowered the large basket with its 600 hens' eggs, 400 ducks' eggs, or 175 geese' eggs, as the case may be. Thirty of these incubators were arranged in two parellel rows of fifteen each. Immediately above each row, and utilizing the warmth of the air rising from them, was a continuous line of finishing hatchers and brooders in the form of wooden shallow trays with sides warmly padded with cotton and with the tops covered with sets of quilts of different thickness.'

The Egyptian egg ovens have been used for nearly 2,000 years, and consist of buildings of dried Nile mud, usually in two compartments. The eggs are in heaps on the ground, above which are shelves for the burning of Camel dung, thus radiating heat. There are several hundreds of these hatching establishments, in some cases with a capacity of 40,000 eggs at one time. Everything depends upon the skill of the operators, who are members of families which have carried out the work for centuries, hiring themselves out to the proprietors for the hatching season. No effort appears to be put forth to secure ventilation or regulation of temperature.

Attention was directed in the eighteenth century to these systems by M. de Reaumur, of the Royal Academy of Sciences, Paris (2). He advocated adoption of Chinese methods. These were not, however, successful, doubtless owing partially to different climatic conditions. During the Nineteenth Century many attempts were made. At the first great International Exhibition held in London, 1851, an incubator was exhibited commanding a large amount of attention. It was on a large scale. The inventor, believing that the heat was communicated to the eggs by actual contact of the hen, used india-rubber on the lower side of the tank, resting it upon the eggs. That actual contact is natural is undoubtedly correct. Its application is difficult. The machine soon passed into oblivion, as did its successors. The first incubator which we operated was in 1877. This was the "Boyle"—a most ingenious machine, but far too intricate and expensive. It had an almost perfect system of ventilation. In 1878 M. Rouiller, of the French School of Aviculture at Gambais, introduced his hydro-

incubator, and with remarkable success. The machine, which is still used in a modified form in France, had no lamp or regulator, the heat being maintained by removal of a portion of water in the tank every twelve hours, and the substitution of a relative quantity of boiling water. Although under these conditions fine regulation was not possible, the hatching results were most satisfactory. The labour and trouble involved were great. Modifications were made by the addition of a lamp at a later date. It was not, however, wholly successful. Introduction of the Hearson incubator in 1883 made the adoption of artificial hatching possible to a degree not known previously. It was an advance upon any machine that had been seen previously, and brought the system within the compass of poultry breeders of every grade.

Are Incubators Practical ?—With the almost universal adoption of artificial methods of hatching, such question may appear superfluous. That is not so. The system is by no means perfect. How far that is due to the method lacking something which a hen supplies and of which we know nothing, or that the machines themselves are responsible, or that control by the operator is at fault, cannot be decided. When incubators were first introduced they were very unreliable, more especially as to temperature. That largely has been remedied. Whether it is as important as is supposed is open to doubt. Success to that extent has been largely responsible for the phenomenal development of Poultry Husbandry throughout the world. Without incubators such could not have taken place. Their use at one time was chiefly confined to exhibition breeders and amateurs, plus a few enterprising practicians. That is no longer the case. Instead of being the fad of a few, artificial hatching is now a practical necessity.

The incubator increases the power of the breeder. Instead of being limited in his hatching by the vagaries or natural instinct of hens, he is now in a position to bring out chickens and ducklings at any season when fertile eggs are available. A result of breeding during the past generation has been to reduce the supply of broody hens, or to delay the expression of the maternal instinct, owing to enhancement of productivity. Breeders dare not have bred for egg-production to the same extent if they had been compelled to depend for hatching upon hens.

The reasons for belief that the future of Poultry Husbandry depends upon artificial methods of hatching and rearing may be briefly stated. Irregularity of hens has been a frequent complaint. Not only are these uncertain as to when they will become broody, except with some of the races which are low producers, but there is always an amount of risk that, should the weather suddenly become colder, they may desert their eggs, which is very serious early in the season and with valuable eggs. Moreover, every hen has to lay a number of eggs before she becomes broody. These may be more valuable as potential chickens than for human food. They could not be most profitably used unless other hens are available or an incubator is at hand. A further recommendation is that with the great increase of demand for eggs as food, and consequently of non-sitting breeds of poultry, and the elimination of those races which become broody early and often, sitting hens become scarcer every year. Many of the more popular sitting breeds, by reason of selection to develop production, are comparatively late in evincing the maternal instinct. At the same time, it is undesirable to dethrone the sitting hen. The wiser plan is to use both systems.

Limitations of Artificial Methods.—Necessary though incubators are, and acknowledging great improvements made in them, the fact is evident that they are second best. There is something in the natural process which no machine supplies. Whether this problem will ultimately be solved it is not possible to suggest. Careful observations over a very long period, and extended experience in many countries, have made that fact apparent. Mortality in incubator chickens is usually much higher than under hens. This may be attributed to a combination of influences, of which the incubator is only one, maybe the least. Many of those who use incubators, in addition to the adoption of intensive methods, breed mainly from immature stock, feed upon unsuitable foods, often mate related birds, and thus are constantly inducing degeneracy.

The subject, therefore, demands careful consideration. A general experience with those who use both natural and artificial systems is that, taking a whole season's experience, which is the real test, the percentage of chickens hatched is higher under hens than with incubators, that the chickens have greater liveability, and that the chickens,

INCUBATOR ROOM, MACHINES AND TRAYS
(Must Hatch Incubator Co. Inc., Petaluma, Calif., U.S.A.)
This great plant has a capacity of 1,800,000 eggs

when reared for stock or as layers, are possessed of a higher degree of constitutional vigour. Seldom is it that the natural standard is attained. In spite of that fact incubators are an absolute necessity, supplemental, however. Wherever, and whenever possible, hens should be used for production of breeding stock, using the machines for very early broods, to hatch layers and table chickens or ducklings, in which directions the opportunities are greater than ever before.

Incubator Houses.*—Where only one or two incubators are used it is not difficult to provide that these shall be where it is quiet, and to give the necessary attention. When number of machines is multiplied other arrangements must be made. The influence upon the atmosphere of a single lamp in a room attached to a machine is small if there is sufficient ventilation. With increased number the combustion of oxygen and rise in the volume of carbon is greatly augmented. That must be kept in view whether the incubator room in relation to the machines be large or small. The climatic conditions should be considered as these are important. In North America, owing to extremes of heat and cold, as a rule the system of incubator cellars, as they are called, has become very general. These are warmer during cold weather and cooler in hot weather than a building above ground. Not only are these more expensive to build, as the soil has to be excavated, but ventilation is much more difficult for obvious reasons. Such are undesirable in more equable zones.

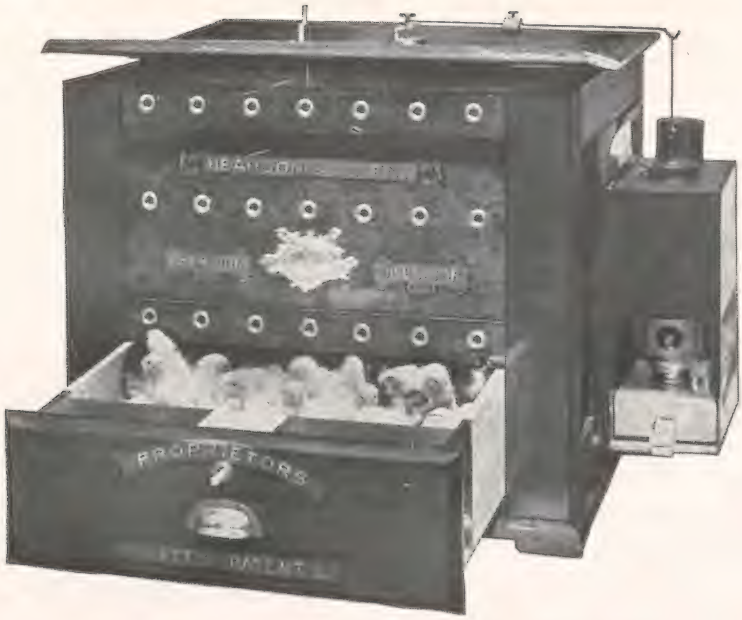
Frequently we have been surprised to note the disregard of effective ventilation in incubator houses. And, further, that the object seems to be to crowd as many machines as possible into a given space, often with scarcely moving room between the rows. Such conditions conduce to failure in hatching. Eggs containing living embryos after the first week are practically breathing air and exhale emanations. A constant circulation of air is required to carry from the egg the gases formed, and to replace these by pure oxygen, which can only be if the atmosphere is pure and constantly changed. Overcrowding of machines involves denial of what is essential. Some years ago we arrived at the conclusion that there should be in an incubator house 2 cubic feet of air space for every egg undergoing the process, combined with a constant circulation of fresh air.

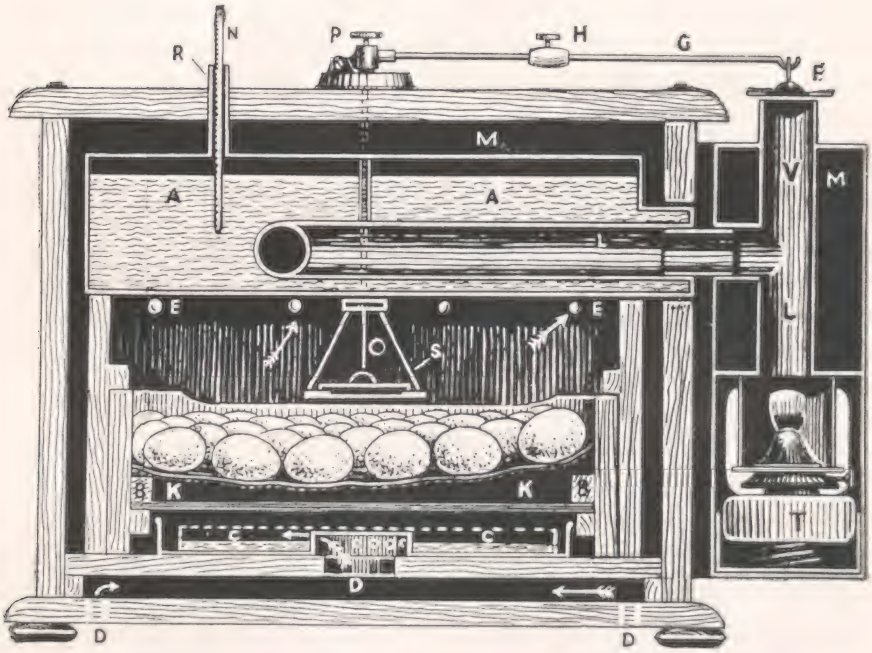
In this connection may be described an incubator house we

* Plate LXXXIV and Plans Nos. 6 and 10.

built which was used most successfully. Twelve incubators each of 100 to 120 egg capacity were used, although there was room for six more. The building was 32 feet in length by 16 feet in width, divided into two sections, one for the machines 27 feet by 16 feet, and an outer room or porch, 5 feet by 16 feet, the last named for stores and re-filling the lamps. The whole stood upon concrete foundations, with a floor of Staffordshire tiles, so that it was firm and solid. The walls were 8 feet 6 inches in height to the eaves, rising to 11 feet at the apex of the gable. The walls were made of double boarding, the wood employed being red deal an inch thick, and well put together. Between was a lining of felt. The roof consisted first of inch boarding, upon which was felt, and covered finally with corrugated iron. The substantial character of the building made the incubator room less subject to variations of outside atmosphere. With respect to capacity the inside gave about 4,000 cubic feet. On the basis laid down it was equal to 2,000 eggs. Part of the success attained may have been due to the fact that number was never reached.

In order to provide for fresh air and to supply oxygen to lamps and eggs, both of which were night and day consuming considerable quantities, a system of ventilation was adopted at that time novel. Outside were eight 3 inch pipes, their terminals with cowls 5 feet above the ground. These were fixed down outside to within a foot of the floor, where they were carried inside and had regulating gratings, so that the current of air could be controlled. The object of bringing the air below the level of the machines was in order that, as it ascended, such as was required for the eggs could pass directly into the egg chambers of the machines without being contaminated by fumes from the lamps, whilst at the same time these lamps were supplied with fresh air making for more regular combustion. In the apex of the gables were fixed large regulating ventilators, so that the air entering a little above the floor was drawn upwards to the machines and the lamps, passing out by the roof. This method of ventilation proved an unqualified success. It is suggestive that our embryonic mortality was comparatively small, probably also due to the fact that the stock were kept under excellent conditions. Windows in the house referred to were four in number, all on the east side, and opened in warmer weather. Under no circumstances should windows be facing south-





HEARSON TANK INCUBATOR.

Upper.—External appearance.

Lower.—Section: A, Tank; B, Moveable Egg Tray; C, Water Tray; D, Inlet of Air; E, Ventilating Holes; F, Damper; G, Lever; H, Lead Weight; K, Slips of Wood; L, Lamp Chimney; M, Non-conducting Material; N, Tank Thermometer; O, Needle; P, Milled-head Screw; R, Filling Tube; S, Capsule; T, Lamp; V, Chimney.

ward, or even south-west. During bright days the doing so would mean increasing the temperature of the room to a very large extent. In order to give shelter this incubator house was placed under a very large walnut tree which kept it cool in the hottest weather. Large double doors opened into the outer room from the outside, and others from the outer to the incubator room. Down the centre of the last named were tables for cooling and testing the eggs. These were fitted with flanges, so that as the eggs were tested these could be placed upon the tables without any danger of rolling off. For the purpose of testing, the shutters fitted to the windows could be closed. The cost of such house was abundantly justified by the results attained in hatching. Cheapness in an incubator house is wasteful, not economical.

Types of Machines.—Increase in the use of incubators has greatly stimulated their manufacture. Of these there are many forms, and more recently much larger machines have become popular as noted below. Some of these have introduced new factors, not alone in capacity but basal principles. So far as the smaller incubators are concerned there are two leading types, of each of which there are many examples, namely, what are known as " tank " and " hot-air " machines respectively, each of which have their advocates. Tank incubators are those which operate by radiation, that is, above the egg chamber is a large metal, usually copper, tank, through which pipes connected with a lamp or other form of heater, heats the water and thus maintains the temperature of the eggs in the drawer. Hot-air machines have no tank. Air heated by lamp passes into an upper chamber the bottom of which consists of felt or coarse material, through which it is diffused upon the eggs, and escapes below. In the tank machine fresh air enters under the egg drawer and is warmed as it ascends, passing out through holes in the sides. As an explanation of the reason why in some countries one form is preferred to the other may be suggested that climatic influence is very powerful, as is elevation. In the eastern sections of the United States hot-air incubators have been very popular, which may be due to advertisements and to the fact that these are usually the cheaper. On the other hand, on the Pacific Slope, where the climate is milder and moister, there seems to be a greater use of the tank machine. It may be that the more extensive use of electricity will lead to further changes. The time, however, for that has not been reached. In the

future with larger operations there can be little doubt but that what are termed "Mammoth" incubators will become more general than the smaller, individual incubators.

Tank Incubators.*—Nearly all the European incubators introduced prior to 1883 were constructed with tanks. The reasons for non-success were want of effective regulation of temperature, inadequate supply to the eggs of fresh air, or that these were intricate and, therefore, too costly, in some instances, or that they involved too much labour as with the hydro, already mentioned. Invention by the late Mr. Charles Hearson of the machine bearing his name, altered the whole position in that it was upon scientific lines. Its widespread use in many parts of the world stamps it as an almost perfect apparatus on a smaller scale. It is excellently designed and carefully made, with a marvellously delicate regulator and, therefore, is reliable. A considerable number of machines by other makers are constructed on the same principle. The regulator consists of a small metal capsule, formed of two pieces of thin brass, hermetrically sealed at the edges. Inside are about twenty drops of a liquid, said to consist of ether and alcohol, which boils at the temperature required to be maintained (104°). So long as the capsule is not subjected to the heat required to expand the liquid, the sheets of brass remain flat. When the heat is increased these distend. The power thus generated is used to work a lever, connected with a rod at the end of which is suspended a metal cap otherwise resting on the chimney at one side. The heated air from the lamp, instead of entering into a tube fixed in the tank and surrounded by water, as the cap is raised, passes into the outer air, and the temperature in the tank and egg chamber gradually decreases. This arrangement thus maintains the heat almost without any change. We have known it keep an incubator to within half a degree for weeks, in spite of varying weather. The eggs are laid upon a concave tray, usually covered with coarse canvas, formed of perforated zinc, below which is a water tray. Fresh air can only enter from below, and, having to pass through canvas saturated with water, any lack of moisture is thus supplied. All that is required is to see that the air is not very cold as it enters, otherwise it would fail to absorb sufficient moisture. That is achieved by maintaining the room temperature at 55 to 60 degs. F. Further details are given in the sectional drawing (Plate No. LXXXV).

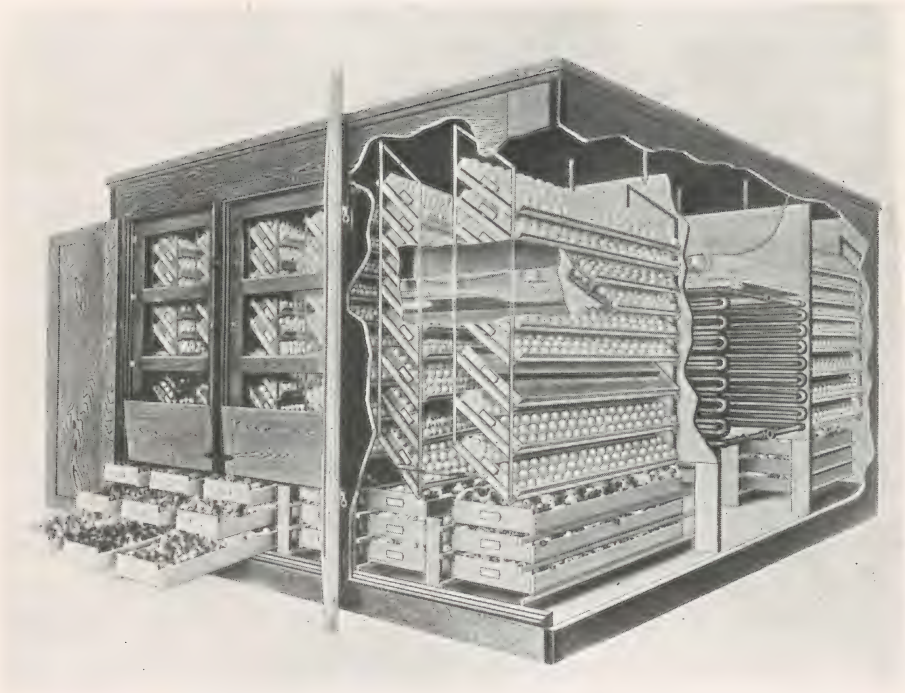
*Plate LXXXV.

Hot-Air Incubators.—Whilst various forms of this type of machine had been brought out in Europe but without success, American inventiveness led to the introduction of several makes which commanded wide acceptance. How far climatic influences were responsible it is impossible to state. Not having a tank considerably reduces the cost of production and, consequently, the price at which they could be sold—an important factor to the majority of those engaged in Poultry Husbandry. The principle between the two types is entirely different. In the hot-air incubator heat is applied to the eggs by diffusion. The air passes upwards by the side of the lamp, during which it is heated, and enters an upper chamber above the egg drawer. This is fitted with a frame upon which is stretched felting, which should be replaced or cleansed to remove any carbon, at least every second year. Through this the heat has to find its way to the eggs below. There are no streams of hot air, and the heat is remarkably regular. The heated air gives the eggs the necessary warmth, and passes into a lower chamber, from which it is drawn outwards by the lamp. The claim was made that there was no need to supply additional moisture as the warming of the air liberated whatever was in it to an increasing extent as its temperature was raised. Experience led to modification of this opinion. Nearly all hot-air machines have a system of water being placed by the lamp so that it is taken up by evaporation as air enters. Regulation is either by a capsule as already explained, or by a thermostat, that is, two strips of metal which expand or contract by application of the heat. This is also connected with a cap over the chimney as in the Hearson. As a rule in these machines the egg trays do not quite fit the egg chamber, leaving a space in front. As there are windows placed in the outer case on a level with the egg tray, the chicks when these have emerged from the shell are attracted to the light, and drop into the compartment below. In practice it has been found, and especially during colder weather, that this system is undesirable, as the young birds are very liable to be chilled, which at this early stage leads to high mortality. Breeders have in many cases been compelled to close up the space left by the makers, and thus keep the chicks in the egg chamber until the time has arrived for removal to the brooder prepared for them, usually when from 18 to 24 hours old.

Mammoth Incubators.*—With development of Poultry Husbandry in the direction of larger establishments, and especially where hatcheries have been commercialised, owing to the vast increase in the sale of day-old or baby chicks, the demand for larger machines has become insistent. Naturally attention was thus called to the egg ovens of Egypt which were, and are, rooms rather than incubators. Many attempts have been made in Europe and America, more especially the last named, to solve the problem, both by what may be termed hatching houses and larger machines, the former of which failed as did many of the latter. The form which up to the point named below was successful, was by the duplication of individual incubators similar to those operated separately, sometimes constructed in two or three stories, each with its own regulation, but heated from one stove. These involved no new principle, save in the one direction mentioned. They have the advantage of separating the various batches of eggs incubated. If the supply of eggs was inadequate to fill all the sections at once, only as many are brought into use as are necessary, and the others operated as more eggs are available. These machines (Plate No. LXXXVI) are steadily growing in favour, and are made of varying sizes.

With the invention of the forced-draught machine by Dr. Smith, of Cleveland, Ohio, U.S.A., a new principle has been introduced, one which, for larger operations, has revolutionised methods of hatching by artificial means. Its success appears to be unquestionable. These are built to a capacity of 40,000 eggs for the great Hatcheries. They are sent out by the Smith Co., whereas those from 20,000 and under are made by the Buckeye Incubator Co., of Springfield, Ohio. The principle, however, is the same. They are built in cabinet shape, and occupy much less space than would be required for the same number of eggs in individual machines. It is unnecessary to describe the machines in detail, as much fuller information can be obtained from the maker's catalogues. The important fact is that after careful personal inquiries from the users, the consensus of opinion is that the average of hatching and of liveability in chickens is high. Recognising that a constant supply of fresh air is essential to successful incubation, and that with increase in number of eggs within a limited space this is difficult to attain, the result is achieved by forced draught. An electrically, or otherwise, driven fan in action all the time maintains a constant cir-

*Plate LXXXVI.



BUCKEYE MAMMOTH INCUBATOR
(The Buckeye Incubator Co., Springfield, Ohio, London and Paris)

Lower: Showing forced draught, moving trays and chick drawers

culation of air to every part of the egg chamber, and as it is warmed on entering the heat necessary for incubation is applied. Not only so, but the eggs are massed one above the other, in many cases to the number of eighteen trays with two at foot for giving more space during the time of hatching. For long we have had the conception that, if the supply of fresh air could be assured, space might be economised by tiers of trays, and have personally made tests in that direction but without success. It is evident that the atmospheric conditions were responsible for failure, as indicated by the Smith invention. Further, the trays are interchangeable, and being pivoted in the centre, the eggs in them can be partially turned or the position changed with great rapidity. So successful has been this system that there are several hatcheries in America with a capacity of over a million eggs at one and the same time.

Management of Incubators.—However well made an incubator may be it is useless unless its operation results in strong, liveable chickens or ducklings. Hence the importance of management. In the earlier days of artificial incubation these birds were generally lacking in constitutional vigour in comparison with those hatched by hens. Something was due to the fact that buyers of incubators were chiefly exhibition breeders, and their stock was highly bred. Further, there was a disposition to remove birds from the place of hatching too soon, and to coddling them during the rearing process, as well as uncertainty in the machines. Experience has shown that success is dependent to some extent, though not wholly, on maintenance of a fairly even temperature, or one that is adequate. A badly ventilated machine results in high embryonic mortality. The inventor of the "Hearson" was one of the first to make provision for a constant supply of fresh air. Too often conservation of heat to economise oil or other fuel was responsible for denying the eggs an adequate amount of oxygen.

Much depends upon the conditions under which an incubator is operated. If we were able to keep the incubator room at the usual spring temperature, say, about 60 degs. F., there would be little difficulty. We have, however, to provide against variations. The upper side of the eggs should be about 102° F. As the inside thermometer has to be placed just above the eggs so that it may be seen, it does not truthfully record their temperature. In a machine with bottom

ventilation, and in which the influx of air is constantly cooling the radiating or diffusing heat from above, the difference may be very important. For this reason, the temperature at which one of these machines is worked, as represented by the thermometer, may be varied as under (hot-air machines one degree less):

	Degs. F.	Degs. F.	Degs. F.	Degs. F.	Degs. F.
Room	40	50	60	70	80
Egg chamber... ...	106	105	104	103	102

It will be found that running incubators on this basis will maintain eggs at practically the same temperature.

Moisture.—The amount of water vapour per cubic foot of air required for successful incubation has never been determined. That a certain amount is essential cannot be questioned. Varying experience in this direction may be due to the atmosphere, not alone as to its moisture content but also to its temperature. More is often found to be required in one place or district or country than in others. The fact that non-moisture machines have largely been abandoned, or are now provided with water trays, proves what is here stated. In this connection is an important fact, namely, that the reduction of weight in eggs, which means loss of moisture contents, is greater than if hatched under hens, indicating that either the machine itself absorbs some of the water in the egg, or that the application of heat by the hen does not eliminate water from the eggs due to the fact that she gives a moist heat, or that the air is absorbent of heat. The wise policy is to follow the directions of the makers, and to be guided by the experience of others operating in the same area.

General Hints.—The following hints are commended to the operators plus the suggestions sent out with any machine:

1. Place the machine where there will be a constant supply of fresh air, carefully avoiding direct draughts.

2. Do not operate it in a room with windows to the direct sunshine, as that means variation of temperature which may be greater than the regulatory power of the incubator.

3. If possible keep the temperature of the room at 55° to 65° F.

4. See that the water trays are regularly supplied and with water slightly warmed.

5. Always warm eggs before putting into the machine by washing

Grading and Packing Day Old Chicks
(Must Hatch Incubator Co., Petaluma, Calif, U.S.A.)

in water heated to 80 degs. This is specially important when eggs are already in it. Eggs should always be clean.

6. Mark the eggs or the tray or the machine, if a small one, with date when put in, and that when due. If no turning apparatus, place signs X and O on two sides to show how far they should be turned. This should be done twice a day, but must be once. Although there are those who say turning is unnecessary, the weight of evidence is against them. A hen is constantly turning her eggs.

7. Cool the eggs twice a day, for ten minutes in winter, and for fifteen minutes at other periods. If the room is warm, longer is recommended. In tank machines the lamp should be lowered or removed whilst the eggs are being turned and cooled, otherwise the heat will be too great when the drawer is again closed.

8. Observe the temperature of the egg drawer whenever the incubator is attended to, as a guide to the correct working.

9. Always keep the lamp or heater properly supplied with oil or whatever fuel is used.

10. Do not open the egg drawer too often whilst hatching is proceeding. When the chicks are out remove the empty shells, and after a few hours remove the birds to drying box, if one is provided, or to brooder.

11. See that there are no vibrations or jarring shocks as these at times cause displacement of the contents of the egg and cause deformities.

12. Fumigate the interior of Machine between each complete hatch, by placing permanganate of potash in a shallow metal dish placed in the egg chamber. Mix with it a small quantity of formalin. Then close up tightly and keep thus for two or three hours, after which it must be washed and left entirely open for several hours.

REFERENCES.

(1) Farmers of Forty Centuries, by Prof. F. H. King, D.Sc., (Madison, Wis., U.S.A., 1911).

(2) The Art of Hatching and Bringing Up Domestic Fowls, by M. de Reaumur (English Edition, London, 1750).

CHAPTER XXVII

REARING—NATURAL AND ARTIFICIAL.

CHAPTER XXVII

REARING—NATURAL AND ARTIFICIAL.

PLACE TO REAR—CHICKEN HOUSES OR SHEDS—COOPS AND COOPING—FORMS OF COOPS—FRESH GROUND—BROODERS—SYSTEMS OF BROODING—INDIVIDUAL BROODERS—COLONY BROODERS—BROODER HOUSES—STOVE BROODERS—GENERAL HINTS—THE EARLY DAYS—FEEDING CHICKENS—THE ORPHANS—DIVISION OF THE SEXES—HARDENING THE CHICKENS.

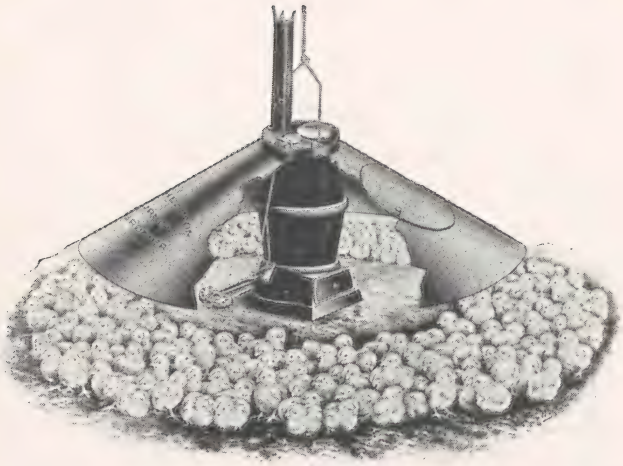
Whilst hatching is limited to the two forms described in the previous chapter, provision for rearing varies to a very considerable extent in accordance with the scope and methods adopted. In this respect, the conditions available and the opportunities presenting themselves, are determining factors. One important point is that whilst natural and artificial methods of rearing must necessarily differ, in practice the period during which such differences exist, does not extend beyond the first six to eight weeks of life, after which they become almost universal. Should the birds be intended for early killing, the system of growing may be much more artificial with the object of stimulating activity of development. This aspect of the case is dealt with in the chapter on Table Poultry. What may be termed forcing, should not be adopted under any circumstance for breeding stock, and to a limited extent with those whose use will be entirely for egg-production.

Place to Rear.—Chickens and young turkeys are very amenable to the influence of damp, whether in the coops or houses where they spend the nights or in the ground over which they run. For reasons which have previously been given, the ideal position is on the southern slope of the hill where is an abundance of trees or bushes. If, however, success could not be attained elsewhere, the work would be limited to a small percentage of people. At the same time, the best possible use should be made of conditions as these cannot be altered. There is

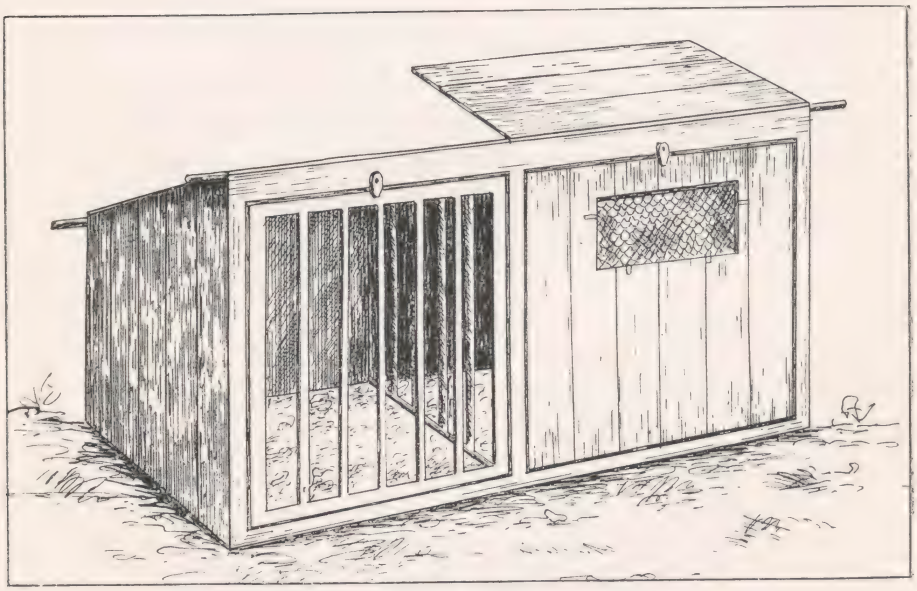
generally a measure of choice. The prime factors are, first, dry, kindly soil, well drained, so as to rapidly carry off the water in wet weather; second, for early broods, a position which at one and the same time, enables them to take advantage of all the sunshine there may be, and yet protects them against strong cold winds and driving rain; and, third, if the soil is good, containing as much natural food as possible, more especially after the infantile stage has passed, the bird will benefit accordingly. In this respect, sand is deficient. Insect and grub life, together with green food are desirable for health and rapid growth. Also, exercise in foraging conduces to development. Clay soil, by reason of its cold nature, retards growth. Whilst that is not serious where birds are intended to be matured as layers, in the case of table chickens or young turkeys, it means an increased cost in feeding and that the flesh qualities are inferior. During very hot weather, exposure to intense sunlight is detrimental. At that period of the year, shade is necessary. Our purpose should be, whilst giving every advantage to the growing stock, to guard against extremes of heat or cold.

Chicken Houses or Sheds.—Where chickens are reared in coops or brooders, the plan generally adopted is to place these out in the open during the ordinary periods of the year. Should, however, it be necessary to undertake rearing during the winter months or very early in the year, a house or shed in which the coop or brooder can be placed is very valuable. It affords the shelter which is essential. Where chickens are to be reared artificially, and the number warrants the cost, a brooder house, described later, is recommended. For natural rearing, one of the best arrangements we have seen was a large, lofty, open-fronted thatched shed, about 60 ft. in length and 20 ft. in depth, wherein the coops were placed and the chickens given freedom to range within its limits. From the fact that this shed had only a solid back and one end, that from which wind and rain were experienced, the birds were practically in the open air all the time. The floor was thickly covered with fresh earth from time to time and in that way an abundance of exercise was given to the chicks. It was, however, customary to use this shed only in the cold or unfavourable weather, moving the coops outside as the weather became more genial. Such shed of the length named easily accommodated twenty to thirty coops, at any rate

PLATE LXXXVIII



HEARSON'S STOVE BROODER



DOUBLE COOP

during the time the chicks were small. We may explain that this structure had been built for another purpose, and possibly it would not be economic to build it specially unless it would be used in other ways during the greater part of the year. It is important that birds be not coddled in any way, as that is always an economic blunder. The object was to make the conditions favourable. An important question with all buildings of a substantial character is that they should be utilised as far as possible the whole year round.

Coops and Cooping.*—On farms where a few batches of chickens are hatched annually, it is only necessary for each hen and her brood to be provided with quarters in sheds or buildings at night and to be given freedom during the day. Where the work is extended and operations are upon a larger scale, it is then necessary to coop the hens, not alone as a question of shelter and protection but to prevent injury to chickens as the mother birds are usually very pugnacious. Many different forms of coops are in use, some of which are too elaborate and unduly expensive. The simpler these are the better. When coops are out on open fields, it is necessary that these shall afford protection to their inmates against enemies, not merely the predatory fox, but the insatiable rat and wild birds of the larger type. Were it not for these, a simple box with open front would be adequate. Whatever form the coop takes, there must be a sufficiency of ventilation, and it is in that direction where many are unsatisfactory. As a rule, many coops are too cramped inside. A useful type is 2 ft. square as that allows sufficient room and air space.

Where the front is barred, and that should always be the case, there is no difficulty about ventilation. Upon dry soils a wooden floor is undesirable and the inmates are much more comfortable even than on hay or straw. Where rats are troublesome, fine mesh wire netting may be stretched across the bottom of the coop, in which case a handful of soft covering material is necessary such as straw or dry leaves. On cold or dampish ground, a wooden floor is essential. This is better if fixed upon cross pieces so that the boards are raised above the earth. The floor and cross pieces should be made separate from the coop proper and fit inside, thus keeping the chickens dry and also facilitating the cleaning. It is an excellent plan to lime-wash out all coops between each occupancy.

*Plates LXXXVIII and LXXXIX.

Forms of Coops.—It is unnecessary to describe at length the different forms of coop in general use, some of which are represented in the illustrations. As already stated, these appliances may be made very cheaply. In the *Illustrated Poultry Record* was described one which is within the limits of all, consisting of a Tate sugar box. This, with a few nails and an hour's work, will form a handy, serviceable coop that may be used as a sitting box also, at a cost of 4½d. (9 cents.) To make, the lid must be taken off the box, and the nails removed, when they can be straightened and used again. One side will form a floor, if required, and the other should be carefully taken off. Two of the lid strips must be cut as a long triangle, 3 inches at the front to 1 inch at the back, and fastened above the open sides, with four narrow pieces inside to hold them firm. The laths, taken from the open side, must now be nailed above the sloping pieces, and with a strip from the lid will make a top having the requisite slope to carry off the rain. There will be just enough remaining of the lid to cut into bars for the front, two of which should be made loose to allow the hen to pass in and out.

One of the earliest forms is the Sussex coop, which is still largely used. It is triangular in shape, and presents at front the appearance of an A. This generally stands about 24 or 27 inches high in the centre, and is the same width at the ground. The sides and back are solid, but the front is made of upright laths, one of which is loose, so that when raised the hen can get out. Of course, the laths, as in all coops, must be sufficiently apart to allow the chicks to pass between them. It usually has no floor. In such dry districts as Surrey and Sussex a floor is not needed in any coop. This type may be regarded as old-fashioned, but it is none the worse on that account.

Another useful form is built square, and may either be gabled or have a top sloping from front to back. Instead, however, of the shutter, which is undesirable, a preferable arrangement is to have fine wire netting upon a frame closely fitting the front, as marauders can thus be kept out. When a wire run is used, that will effect the same object. In fact, a run should generally be used for the first few days, except when the hen is allowed out; otherwise the chicks are liable to stray and not be able to find the way back.

Fresh Ground.—Sufficient evidence has been given as to the dangers

involved by manurial influences. That applies to young birds even more than in the case of adults, from the fact that they have less power of resistance. Nothing will more speedily taint a piece of ground than a brood of chicks, if these are continuously kept upon it. Where a mistake is generally made is by cooping the young birds upon ground which has been occupied by older stock. It should be recognised that continuous use of ground means that it is deprived of elements which are necessary for the chickens, and in addition, food is apt to become contaminated. Fortunately, as the period of use should be comparatively brief, mother earth has the opportunity of restoring it to normal condition. In all cases, the older stock should not be given access to where young birds are being raised. In larger operations, by natural methods, the coops should be arranged in a field, fairly wide apart, so that these may be moved either every day or every other day and the plot of ground will not be occupied again for, say, a fortnight.

Under the circumstances where chickens are reared on a very restricted area and it is impossible to move the coops in the way indicated above, the only thing to be done is to bring fresh soil and scatter it around the coops. Removal and absolute cleanliness are the chief factors making for success in natural rearing.

Brooders.—Great changes have taken place within the present century in respect to artificial rearing of poultry. When first introduced, brooders were of the individual type; that is, whilst accommodating a larger number in one batch than could be cared for by a single hen, the flock was a unit and handled as such. Each of these formed a colony and was separately controlled, in which artificial warmth was substituted for the natural. The brooder was moved on to fresh ground in the same manner as are coops. Our experience, provided the apparatus was satisfactory and the management efficient, was that excellent results were obtained. With development of Poultry Husbandry and, correlatively, increased use of incubators, enabling greater numbers of chickens to be brought out at one and the same time, the system was expensive in equipment and for labour. For each thousand chickens, there would be required a score of separate brooders. Apart from the cost of these, the regulation of twenty lamps, the feeding of twenty groups of birds, and the regular cleaning

of the same number of brooders, involved a large expenditure of effort and of time. Moreover, not only was the work unpleasant in unfavourable weather, but the risks of loss through lamps over-heating or going out, were considerable. As a consequence, with the growth of Poultry Husbandry in respect to extention of operations, the desire for concentration and adoption of a central method of heating became manifest. Many of the methods adopted, failed. These ignored the fact that chickens are living entities, and cannot be made amenable to what may be termed factory methods to the same extent as may inert material. In this connection may be mentioned that many efforts have been made, more especially with the view of producing table chickens, to adopt systems which were intensive in the extreme. One of these may be referred to, namely, that nearly forty years ago, the writer visited a farm near Metz in Germany where the chicks were being raised to a killing age entirely under cover, and, at various times, we have inspected plants of a similar nature, in some cases where the birds were kept for the whole of their natural lives upon shelves. Although some birds appeared to be capable of withstanding these conditions, the mortality was enormous and each enterprise has come to an untimely end. Those who take up Poultry Husbandry as a business will be well advised to avoid methods of this nature.

Systems of Brooding.—The methods which are adopted in different countries resolve themselves into three classes, largely determined by the extent of operations. These are, first, individual brooders, each of which is distinct and operated separately; second, colony or fixed houses, fitted with portable brooders, which can be removed when heat is no longer required; and, third, range brooder houses, which vary very considerably in the method of heating. It is evident that the first most of all recognises the value of distribution and that it may, if properly carried out, be associated with fresh ground. Colony houses can also be utilised in this way, but as a rule, remain in the position where placed for the whole of the season. With the third method, much depends upon the cultivation of the soil during the periods of the year when chickens are not being reared.

Individual Brooders.*—Although previous to the year 1877 several forms of brooders had been tested, in that year we first used one of these machines. It was a very primitive affair which need not be

*Plate LXXXVIII.

Reaking by Hens under Ideal Free Range Conditions
(Messrs. John Chivers & Sons, Ltd., Histon, Cambs., England)

described. Keeping the lamp burning was by no means easy, especially during unfavourable weather. The final results, however, were remarkable. Out of about 80 chickens, all save two were reared. The apparatus was placed under a rough shed with open sides, over two of which sacking was suspended as a shelter against wind and rain. The birds could not leave the brooder without being exposed to the elements. Encouraged by success, the following year a shed was built for the brooder. This gave the birds plenty of space under cover. It had a glass front and they were allowed outside when conditions appeared to be favourable. Strange to say that *pro rata* mortality greatly increased. That lesson has never been forgotten. It is the experience of others that protection may be carried to an extreme, and the birds be coddled to death.

For the small poultry keeper who buys a batch of day-old chicks, and has not a hen available to take charge of them, a simple and inexpensive brooder may be used of which several forms are sold. Or, on the other hand, a hurricane lamp with a radiator cover may be suspended inside a large coop and as a rule will give sufficient warmth. A paraffin barrel cut in half will make two good brooders, when fitted with loose floors, lamp, casement and chimneys. Plenty of ventilation holes are a necessity. Much of the success is due to the fact that the flocks are small.

As a rule individual brooders of a smaller size, that is such as come into the first class, are fitted either with handles or wheels at one end so that they can be easily moved about. Some of these brooders have hinged tops or covers whilst others have a sliding lid which, in many directions, is to be preferred. These are for the purpose of giving access to and cleaning the interior. Usually they are in two compartments, first, the brooder proper, that is, the sleeping quarters, and, second, a covered run, which is wire netted in front and large enough to accommodate the chickens when kept within it.

The methods of heating varies. In some brooders, such as the Hearson, which is one of the best type, this is applied by a small radiating tank or boiler, heated by a lamp placed in the covered run so that no fumes can enter the sleeping compartment. In others, a special or hurricane lamp is placed within the brooder around which is a circle of wire netting to keep the birds from actual contact with the

lamp. The prime factor in all such apparatus is that there shall be a regular and abundant circulation of fresh air, so that the atmosphere may be perfectly sweet and that the carbonic acid gas, exhaled by the chickens, may be carried away. Too often, in order to conserve heat, ventilation is checked.

Within recent years, fireless brooders, that is without artificial heat, have been introduced, and with some measure of success, dependent mainly upon the skill with which they are managed. The theory is that by conservation of natural body heat of the birds, it has been thought that during the greater part of the year these can be reared successfully. A claim is made that whilst these chickens may not grow as rapidly as those in heated brooders, they will feather much better. It is realisable that in the warmer countries, such a system may be successful. In those which are cooler, more especially during the rearing season, the system is unlikely to be adopted. Moreover, during wet seasons of the year, it is difficult to keep the fireless brooders from becoming damp and chills result. One of the main weaknesses in the individual type of brooders, apart from lack of effective ventilation, is that they are not properly lighted. Wherever individual brooders are used, the chicks should be encouraged to go out into the open air to the fullest extent, even though the attendants are fearful of the consequences.

Colony Brooders.—It is now many years ago since the first colony brooder was brought to notice. That was in France. An ordinary portable house was fitted with the brooder which could be removed when the chickens no longer required heat. In large measure this arrangement was due to the fact that French breeders regard it as desirable for chickens to remain in the same environment after they had passed that stage. The suggestion was that the houses and chickens together might be removed to fresh ground, but that they should, at any rate until fully grown, have the same habitation. For this opinion there is much to be said.

Since that time great progress has been made and many forms of colony brooders have been adopted. It is not necessary to describe these in detail as the principle is simply that the brooder is not structurally a part of the house but is merely placed within it. That is economic in equipment, for the reason that the houses can be used

Upper: Continuous Brooder House, 24 Pens. *Lower:* Interior of above
(Purdue Experiment Station, La Fayette, Ind., U.S.A.)

during the remaining period of the year for stock. Further, such system forms an integral part of an extensive method of rearing, in which the advantages of distribution and free range are secured. Again it is of the utmost importance to ensure that the birds, during the growing stage, shall have the advantage of sufficient ground. Further, houses for this purpose must be well lighted. As far as possible it is necessary to use open, that is, wire netted fronts. For very early broods, glass is generally employed, in which case the observations made in Chapters XVII and XXII should be carefully studied.

Brooder Houses.*—The third class named above has been undergoing a process of evolution in the light of widened experience. Many long range houses have been erected with outside runs and, in some cases, almost elaborate in their arrangements. In the majority of these, the houses are divided into compartments, holding 100 to 200 young birds in each. Various systems of heating have been adopted. Elaborate arrangements by pipes heated from one centre, either a stove or a lamp, being installed. For these, in each compartment is placed a wooden cover called a "hover", in which the birds could obtain whatever heat is thought to be necessary for their development. As it has been customary to move the birds from one compartment to another during the stages of growth, the pipes are elevated towards the extreme end so as to give a greater amount of room. It is not too much to say that the greater number of pipe installations have failed to achieve the success which was anticipated and, in many instances, these have been abandoned and individual brooders substituted. Attempts have been made to keep the whole house at a temperature which was sufficient to maintain the comfort of the inmates. These again have failed.

It will be realised that the temperature of a brooder house is of considerable importance. Mistakes are frequently made by subjecting the birds to a greater amount of heat than is desirable. During the first few days they are required to be kept warm and are very subject to chills. During that period the temperature should be even, not in excess of 90 degrees F., and, say, at intervals of three days, reducing it, until 75 degrees has been reached. As the birds grow, they will generate a much larger amount of body heat and are able by exercise to keep the blood circulating rapidly, which is the best means

*Plates XC and Plans 7 and 10.

of maintaining warmth. Much mortality in chickens arises from giving too much heat, as it is stimulative up to a given point and devitalises the system. A further point is that the atmosphere in a brooder house should be pure, and it is needless to say that absolute cleanliness is essential. Sufficient has already been said in previous chapters to indicate the importance of sunlight. So far as growing chickens are concerned, they will never make the progress which is desired unless they can have the benefit of the sun's rays. For that reason, open-fronted brooder houses are much more effective than those with closed fronts. For protective reasons, glass has been largely used in brooder houses. More recent research has shown that except for the reason chicks are happier where there is plenty of light, the use of artificial window glass has not proved successful, and that, as a result, such deficiency diseases as leg weakness are more evident with birds raised in brooder houses than with those in individual brooders where they get out into the open the greater part of the day. It would appear that if what is known as vita glass is used, which passes the shorter ultra-violet rays of the run, the risks indicated above are obviated. It is desirable to point out that brooder houses should be so placed that the birds can go out into the open whenever they wish to do so, that is, so soon as they have passed the infantile stage. Again may be emphasised the importance of fresh ground for chickens, and that they be encouraged to scratch in the earth as much as possible. The use of litter upon the floor of a brooder house, desirable though they be to encourage exercise, is only second best as compared with what takes place outside. It is for this reason that in many cases, smaller and portable brooder houses are preferred. For these latter, a single house with a floor space of 10 square feet is a useful size, accommodating one brooder.

Stove Brooders.*—Whilst Colony brooders with moderate-sized flocks undoubtedly give the best results, provided that efficient attention can be given to them, in this respect is a question of cost, both of equipment and of labour. Many inventions have been placed upon the market with a view of solving this problem on a commercial basis. As already indicated the pipe brooder system has not proved a success, nor have sectional brooders in a continuous line yielded the results desired, both in number of chickens reared and vigour of the

* Plate LXXXVIII.

birds. The system which has commanded the greatest amount of success is by the use of stove brooders, of which there are many forms offered for sale. In these, there is a stove, heated either by coal or coke or oil, above which is a radiator or deflector, throwing the light around for a considerable distance. These stoves are made so that they do not require frequent attention as they are slow in combustion. In some of them a thermostat is fixed so that, if the heat rises above whatever temperature is thought desirable, it can be shut off or allowed to escape. These brooders have of course a chimney, carrying all fumes into the open air, and are so made that only the heat is radiated in the way indicated.

In practice it is usual to place one of these stoves in a house, or in each compartment of a longer range building. In some cases, large stoves have been made, which were, so far as capacity is concerned, capable of breeding 500 chickens. Such massing has proved to be a mistake, and it is generally found that smaller brooders with 150 to 200 chickens are quite large enough, and, in fact, these would be more successful if the numbers were still further reduced. There is all the time a great tendency towards efforts at mass production. It is customary to place around the brooder, say, immediately below the line of the outside rim of reflector, a circle of wire netting to prevent the birds crowding underneath as there the heat would be too great. If one of the moderate-sized stoves is placed in a house, say, 10 feet square it will be found in practice that the chickens will distribute themselves over the floor and obtain as much heat as they require. Those which prefer to do so, can keep on the outer circle where it is somewhat cooler. The advantage of this system is that there is no hover between the roof and the floor, as a consequence of which there is less danger of tainted atmosphere, provided that the ventilating system is effective. The main danger of this method is by expecting from it more than can possibly be achieved, and that the crowding of great numbers of birds together is not to be commended.

General Hints.—To summarise the points named above, so far as the artificial rearing of chickens is concerned, it may be stated that:

1. That there shall not be overcrowding, and that every bird shall have sufficient space. Sometimes overcrowding is the result of insufficient heat. Only observations can show where this is the case.

2. Every care must be taken to see that lamp or stove receives regular attention and that the flues are cleaned out systematically. Any failure in this respect may result in the stove firing and loss of the whole brood.

3. Whilst for the first few days warmth must be well maintained as already stated, it should be steadily reduced and at four to five weeks, it need not exceed 65 to 70 degrees. In mild weather the temperature should be further reduced during the day. So long as the chickens are seen to be happy and contented, it may be assumed that the heat is being applied sufficiently. If they are seen to be gasping for breath that indicates the temperature is too high.

4. Cleanliness in the brooder house is of the utmost importance.

5. As already indicated, if the birds can be got outside, save in very severe weather, the better they are likely to thrive.

The Early Days.—As previously stated, nature always provides for the separate existence of every living creature. Therefore, it is unnecessary to supply food to chickens until they are from 60 to 72 hours old. The yolk bag which is absorbed in the abdomen prior to the breaking of the shell, contains all nutriment requisite to the time as stated. Great harm often results by tempting young chickens to eat before there is any need for them to do so, and many derangements of the digestive organs result. Nature understands this question, and as soon as food is required, the chickens will show signs of seeking for it. Where they are being reared naturally, this can be left to the hen's instinct. Under artificial conditions, the risks are that the anxiety of the owner may lead to adoption of methods which are harmful. From 72 hours, food should be supplied, though there is no need to be anxious if it is not consumed

Feeding Chickens.—Much study has been given to the feeding of young chickens in different countries. This has been necessary owing to the great increase of mortality resultant from the adoption of artificial methods. How far such mortality is due to pre-natal influences, such as lack of constitutional vigour of the stock, and to what extent it is influenced by the process of hatching and rearing, have never yet been determined. Moreover, the tendency under specialised methods, and especially where these are more or less intensive, is towards what may be termed as pampering, which not only means feeding upon

foods that are not natural and, to some extent, may be forcing, but also provide everything that appears to be required, without the physical activities of the chicken being called into play. Under natural methods of rearing, there is much less danger of loss from these causes. The hen knows a great deal better than we do what is good for her brood, and if permitted to do so, will lead them about in search of those earth products, vegetable or animal, of which we know nothing, and are, therefore, unable to supply. Under artificial conditions, even where the birds are given an outside range, such opportunities are distinctly limited. Frequently one wonders whether the old systems are not better. The plan generally adopted in former days, was to feed for the first three or four days upon hard boiled eggs chopped fine, mixed with stale bread crumbs, and slightly moistened with milk. Following this it was customary to give alternately for the next two weeks, Spratts Biscuit meal, oatmeal, ground oats, and boiled rice. From the period named the boiled rice was given only seldom, although chicks are very fond of it, and broken wheat or buckwheat, or in some cases, crushed oats, were added to the diet. It cannot be denied that these methods, though they may appear antiquated, yielded very much higher results than is now the case. It was not, however, so successful when brooders were employed, which may be explained by the fact that what had been naturally obtained by the chicks was denied to them.

For some time it almost appeared that artificial rearing on a large scale was an absolute failure due to the heavy mortality. That was equally true in Europe and America, where very heavy losses were experienced. After very careful observations, the conclusion arrived at was that this was due to several causes such as those mentioned above, but that it was emphasised by denial of the opportunity for exercise by the chickens.

Here may be explained that the organs and muscles of the body are meant to be used as much as possible. That has been recognised by adoption of the scratching-shed system for laying hens, and it needs to be applied to chickens also. The chief trouble which was experienced was in an inflammation of the bowels leading to diarrhœa or dysentry, and in some cases the lungs were also affected. It may be that the birds were suffering from what is now known as Bacillary

White Diarrhœa, of which at that time, we knew nothing. It was apparent that lack of exercise made the birds more subject to chill, and, if the weather was at all damp, they would be affected to a considerable extent. After three seasons' experience, in which the losses were very heavy, it was determined to adopt somewhat drastic measures in that the conditions were changed, but that the system of feeding was not altered. Brooder houses and open-air brooders, with both of which there had been heavy losses, though most largely in the former, were carefully tested so far as the inmates were concerned. The point was that the chicks should have to work for their living, and that the food to a large extent consist of seeds and small grain, in addition to which there was an abundance of grit thrown among the chaff, fresh vegetables such as lettuces and young cabbages, and, of course, fresh water. The results were startling in the extreme. The mortality was brought down by 75 per cent and, although the birds perhaps did not grow quite as rapidly, they were stronger and better in every way. The chicks usually had a morning meal of soft food, after which until the evening, they had nothing but what they could find amongst the chaff. They seemed to be always eating, and always working as is usual under natural conditions. There was no saving in cost, although to some extent the plan was economical in labour. Of course, care had to be taken that sufficient food was supplied, and the chaff was renewed about every ten or fourteen days. In this connection may be mentioned that at the time named the dry mash system was not known. Very excellent results have been reported. Here again, however, our view is that these in considerable measure will depend upon the extent to which the birds can obtain those natural elements which are found in the soil or growth.

The following is the dietary which has proved most successful under this system :

First fortnight : Millet, dari, buckwheat, canary-seed, in equal parts, and granulated meat.

Second fortnight : Spratts meal, cooked rice or oatmeal, dried off with ground oats, adding a little bone-meal and 15 per cent of meat as morning feed ; grains as above, with broken wheat added at other periods of the day. Gradually reduce the canary-seed.

When a month old : Omit small seeds and add cracked maize.

When six weeks old: Barley-meal, toppings and meat, mixed and given warm in the morning; whole wheat, barley, oats and cracked maize; green food all the time.

A word of warning is necessary where it is intended to fatten the chickens. Under these circumstances they should be fed to a greater extent upon soft food after they are a month old, otherwise the crop will not be distended enough to enable them to bear the cramming during the final stages—that is, to hold sufficient food for the best results.

As an indication of systems which are now adopted, we quote, by consent, recommendations by Mr. Tom Newman, secretary of the Scientific Poultry Breeders' Association (1) who has given much study to feeding questions.

"As a first feed a good brand of dry chick feed should be given, and a hopper of dry bran should be always before the chicks. A good chick feed consists of the following:

60 lbs. Finely Cracked Wheat.
25 ,, Split Groats.
10 ,, Fine Maize Grits or finely kibbled Maize.
5 ,, Canary Seed.

On the seventh day the chicks should be placed upon the following mash:

21 lbs. Bran.
10 ,, Alfalfa Meal.
35 ,, Middlings.
21 ,, Sussex Ground Oats.
14 ,, Maize Meal.
8 ,, Fish Meal.

This mash can be fed wet or dry, and if dry should be always before the chicks, and the hopper of dry bran will then be removed. The mash should be continued until the chicks are three months old, when they can be placed upon the following:

3 lbs. Bran.
4 ,, Middlings.
1½ ,, Sussex Ground Oats.
½ ,, Maize Meal.
½ ,, Meat and Bone Meal.

This is a dry mash. If a wet mash is preferred a better one would be:

1 lb. Bran.
4 lbs. Middlings.
1 lb. Biscuit Meal.
1 ,, Sussex Ground Oats.
½ ,, Meat and Bone Meal.

The chick feed should only be given as a scratch feed during the day, but they should be allowed as much as they will consume as the last feed.

Chick mixtures containing millet, dari, split peas, hemp and lentil should be avoided, as all these seeds are extremely difficult of digestion; far more so than the grains we give the adult fowls, and it is not common sense to feed the chick, with its tender digestion, on a food which is more difficult to digest than that which we give to a hen.

The above grain feed may be continued until the chicks are six weeks old, when they may be placed upon a cheaper and coarser grain preferably of:

6 parts Small Red Wheat or Cut Wheat.
3 ,, Whole Groats.
1 ,, Maize Grits.

Every effort should be made to give the chicks milk in some form during the first six weeks of their lives: skimmed milk is best. If this is not procurable dried milk should be used in place of half the fish meal in the mash, if it is not possible to entirely replace the fish meal with it.

Green food should be given to the chicks after the sixth day; lawn cuttings, lettuce, dandelion, chick-weed, water-cress, etc.

For comparison may be given the Cornell Ration for feeding recommended by Professor James E. Rice (2).

"This ration will give the best results when the chicks are given range on fresh sod and shade is provided.

Grain Mixture No. 1.

5 lbs. cracked corn (fine)
3 lbs. cracked wheat
2 lbs. pinhead oats, steel-cut oats, or oat flakes

Grain Mixture No. 2.

6 lbs cracked corn (medium)
4 lbs. wheat

Grain Mixture No. 3.

500 lbs. cracked corn
200 lbs. barley
200 lbs. wheat
100 lbs. heavy oats.

Mash Mixture.

25 lbs. yellow corn meal.
20 lbs. wheat bran
20 lbs. flour wheat middlings
10 lbs. fine ground heavy oats
10 lbs. fine ground meat scrap (50-55 per cent protein)
5 lbs. bone-meal
10 lbs. dried milk products (use part buttermilk)
½ lb. fine salt
1 per cent medicinal cod liver oil.

The Orphans.—Under general conditions chickens are deserted by their mothers when about 6 to 8 weeks old and the same should be the practice with those that are artificially reared. The nearer we get to nature's methods, the better. It is necessary to make provision for the orphans at this stage. What that is will depend upon the season of the year and, to a certain extent, the nature of the chickens. Should the weather be warm and they are of a hardy race, there is no better plan than placing them in a portable house fitted with special perches, not less than 6 inches broad with the edges carefully rounded off. Some breeders do not permit their chickens to roost on perches until they are well grown, making a thick bed of sand or straw on the floor. In unfavourable weather, it is often desirable as a temporary measure to transfer the chickens that have been artificially reared to what is known as a cold brooder which should be placed in a sheltered position. Whilst it would be folly to expose chicks unduly, more harm is done by coddling them than relying upon their natural virility.

Division of the Sexes.—The male and female chickens should be separated as soon as the sex of each or both can be distinguished. In this respect, there is a great deal of difference in breeds so that no time can be fixed. Usually the combs of the young cockerels are the first indications of sexual development and, immediately these are evident, the time has arrived when separation should take place. Among the lighter and quicker growing breeds that may be any time from four to eight weeks after hatching; in the heavier races the sex cannot be distinguished thus early.

Hardening the Chickens.—For such birds as are intended to be

reared either as laying or breeding stock, it is undesirable to attempt any forcing for growth such as is justifiable in those that are to be killed at an early stage. A measure, therefore, of hardening is desirable. Whenever possible, the wiser course is to put the birds out on range where their foraging instinct can have full play in which they can obtain full exercise and that, in turn, leads to development of bone and muscle. Such can usually be done with safety at from ten to twelve weeks according to the breed. Upon good soils, and especially at the time of year when the plant growth and vegetable life are abundant, the food can be principally grain, varying with dry mash in hoppers. Where the environment compels restriction, runs should be provided as much as possible and roomy scratching-sheds, the grain being supplied in litter.

REFERENCES.

(1) Modern Chick Rearing, by Tom Newman (Rudgwick, Sussex, 1926).

(2) Practical Poultry Management by Professors James E. Rice and H. E. Botsford (New York, 1925).

CHAPTER XXVIII

EGG-PRODUCTION AND PRESERVATION.

CHAPTER XXVIII

EGG-PRODUCTION AND PRESERVATION.

SOURCES OF EGG-SUPPLY — IMPROVEMENTS IN EGG-PRODUCTION — FACTORS IN EGG-PRODUCTION—UNEXHAUSTED CAPACITY OF HENS —PARENTAL INFLUENCE—FECUNDITY AND ITS DEVELOPMENT—APPLICATION—EFFECT OF EARLY LAYING—TRAP-NESTS—WINTER EGG-PRODUCTION—BREAKING-OFF BROODY HENS—LAYING SHEDS—ILLUMINATING POULTRY HOUSES—PROFIT ATTAINABLE—CROSSES FOR EGG-PRODUCTION—SIZE OF EGGS—COLOUR OF SHELLS—PRESERVATION OF EGGS—OBJECT OF PRESERVATION—WHO SHOULD PRESERVE—WHEN TO PRESERVE—WHAT TO PRESERVE—WHERE TO PRESERVE—METHODS OF PRESERVATION—COLD STORAGE—OTHER METHODS—HOW LONG TO KEEP—INFECTION OF EGGS.

During the latter half of the Nineteenth Century there was a steady growth in the demand for eggs and recognition of their food values, with increasing momentum in the two last decades of that period of time. Such advance in consumption may be attributed to several causes, namely, higher standards of life in great numbers of the people following upon increases of income; the changing conditions under which these live and work, necessitating finer and more easily digested food; improvement in quality by adoption of better methods of breeding and management; the ever increasing supplies from other countries where effective organisation in marketing had been introduced; and the publicity given to neglect of a profitable source of income by farmers, and a valuable article of food by consumers. In this direction what has been termed "the gracious influence of foreign competition" has been a potent force. What is here stated has been apparent in almost all countries, most especially those wherein commercial and industrial developments have led to congestion of population. The stimulus thus given led to adoption of methods some of which were unnatural to an extreme, and others that were

non-commercial. During the Twentieth Century great advances have been made in this direction. Experience has been costly yet effective, in that this has indicated what can and what may not be done. The work of selective breeding has led to advance in average fecundity. There has been, more especially during and following the Great War, a considerable increase in prices of eggs, enabling those who operate on special lines to meet the higher charges and obtain an adequate profit on their enterprise. Egg farming, which formerly was a failure, is now a recognised branch of husbandry, and is offering a comfortable living to those who have the skill and energy to undertake the business, distinct, that is, from the conduct of breeding farms already referred to. In addition to specialists the great mass of farmers are at last coming to realisation of the fact that poultry form one of the most profitable branches of live stock.

Sources of Egg-Supply.—In what are termed the producing countries, that is, where the population is widely distributed and the number of those engaged in growing crops or breeding and raising stock is equal to or in excess of the purchasing consumers, the profitable method of egg-production is in association with farming, whether the occupations be larger or smaller. Under these conditions specialised poultry husbandry in this field has not attained success, from the fact that markets must be sought elsewhere, sometimes at great distances, and that the returns by reason of lessened values owing to time required for transportation, and expenses of marketing, decrease returns below the profitable point. Examples of the former are Denmark and Ireland, each of which has developed poultry husbandry to a remarkable extent. The home demand is comparatively small, and the products have to be exported. Success has been achieved by each farm or holding keeping a flock of poultry of a reasonable size, and by organised marketing. In consuming countries, although the bulk of the supplies of eggs and poultry are derived from general farms, there is now opportunity for operations on special lines for market production, from the fact that outlets are available either close at hand or within easy reach. The products can be marketed frequently and speedily. In arriving at the final stages these have to pass through few intermediaries, and the costs are small so that the returns are at the maximum. Examples of what is here stated are seen in several

countries, of which may be mentioned in England, Lancashire and the West Riding of Yorkshire, and the South-eastern counties; in the United States such is the case in New Jersey and New England. The fact remains, however, that something like ninety per cent of eggs and poultry annually are derived from farms.

The main sources of supply are, therefore:

1. **General Farms,** on which the poultry is supplemental. As these have been dealt with in Chapter XVIII further observations need not be made.

2. **Special Egg Farms.**—On these there is usually a greater or lesser amount of intensification, in many instances much more than is justified. There is abundant experience that many failures have arisen from disregard of natural factors, and that for permanency of this branch to a much greater extent in the future it will be necessary to extend the range, even though for winter egg-production there may be restriction in this respect. That subject is discussed in Chapter XXI. In this connection may be mentioned that Breeding Farms contribute considerably to the food supply.

3. **Cottagers and Allotment Holders.**—Whilst production under these conditions is individually small, it is large in relation to the area of land occupied, and considerable in the aggregate. By reason of low costs the margin of profit is satisfactory. Every facility should be afforded to this class. Those who hinder or prohibit the keeping of poultry in rural districts by cottagers or agricultural labourers, as is sometimes the case, deserve the severest condemnation for their action.

4. **Urban and Suburban Residents.**—In this instance, also, the number of fowls kept may be individually small, yet the total is great. The produce is usually consumed in the owners' households, which is an important contribution.

Improvements in Egg-Production.—Exceptional productiveness on the part of individual hens is by no means new. Instances could be cited for more than a hundred years of hens and small flocks which had made high records. At that time demand for and prices of eggs were much less than is now the case. Selective breeding was almost entirely in the direction of racial characters. Within the past generation a great change has been brought about by the ever increasing con-

sumption of eggs, and by the establishment of egg farms on which relativity of output is of the utmost importance by reason of the higher costs of feeding, etc. There has undoubtedly been an increase in average productivity, which has altered the position completely. Up to a certain point this advance is due to the introduction of heavier laying breeds, which have been known for centuries, and to selective breeding for eggs. In this respect it is important to be able to discern which hens are most productive, not alone by reason of the higher return thus obtained, but, most of all, that by using these as breeding stock the quality may be transmitted to the progeny. What has to be attempted is to eliminate the poor layers. Progress has been made though not to the extent which had been anticipated. All such development must be slow. In it there are bound to be many disappointments. Breeders are generally in too much of a hurry. They have sought to accomplish in two or three years what would need a cycle of time, even if it were possible. Marvellous individual records have been attained, well in excess of 300 eggs per annum. Such are deeply interesting, and have a high advertisement value to the breeder. Their service in transmitting this power has yet to be demonstrated. Productivity and reproductivity are not the same. One fact is forgotten, namely, that correlative with adoption of pedigree breeding there has been the influence of improved methods of management and feeding, each of which have undoubtedly had a large share in the advance made.

Factors in Egg-Production.—Although knowledge of the factors which enter into productivity is inadequate and incomplete, there are some which can be indicated. One of these has already been mentioned, namely, races of fowls and ducks which yield a high average of eggs. These are largely the races that are lighter bodied, and which, by their adaptability to a new environment, and responsiveness to good treatment, have proved of great value. At the same time, individual selection has been more carefully carried out. Not less important is the fact of elimination of less productive hens, and especially when these have passed their third year, unless they are regarded as valuable for breeding. This culling, as it is called, is necessary for the attainment of profit. When a hen is bred and fed for heavy egg-production, her period of profit does not usually exceed

three years. There are, however, exceptions. Generally speaking she is most prolific in her first laying season, decreasing about 25 per cent in the second, and to a like extent in the third. On the other hand, with greater age her potentialities as a breeder, unless exhausted by over-production, are higher in her second and third years than in the first. For that reason the use of yearlings for stock purposes is more and more regarded as undesirable. Progression which may be made depends largely upon racial and individual selection.

Improvement of environmental conditions has had a powerful influence. Modern poultry houses are vastly superior to those formerly in use. Instead of the close, over-crowded, ill-ventilated roosting quarters at one time general, spacious scratching-sheds, open-fronted, light, and airy, have done much to increase fecundity. Upon that point reference is made in Chapter XXII. To this may be added that an adequate supply of oxygen is essential to the complete digestion of food, and that with the larger amount of nutritive elements required, as the *pro rata* number of eggs is increased, the consumption of food is much larger.

Generally speaking the effect of changed conditions is stimulative, though that is not always the case. Most changes, however, are favourable. It is often found that egg-production, and in some cases that of flesh, is enhanced when transference takes place from one country or district to another. This may be transitory, extending over two or three generations, or permanent. That is an explanation why breeds are frequently more prolific in a new environment than was the case in the original habitat. It is a justification for the practice of regularly introducing fresh stock. By line breeding, which is undesirable for those engaged in production, much may be done where the flocks are large to avoid the necessity for what are termed out-crosses, that is, introduction of birds of the same breed but a different family. Experience is to the effect that there are limits to such system, and that fresh blood becomes a necessity. Were it not so the business of breeding farms would be largely curtailed.

Feeding exerts a powerful influence for good or evil. Excess of food tends to reduction of fertility, and also of fecundity, by congestion of the organs of the body. Where plain food, and an adequate supply of that which is natural, is supplied, containing the constituents

which go to form an egg and without an undue amount of fat, the instincts of fowls may be trusted to determine quantity. Upon this aspect of the question, however, knowledge is superficial, although some progress has been made. There is no need to tempt the appetite. It is possible to increase the number of eggs at a cost which makes the doing so unprofitable.

Constitutional vigour is an essential factor. Weakly hens are sometimes good layers. Where that is the case their duration of life is brief. Activity and laying go together.

Unexhausted Capacity of Hens.—At one period there was a prevalent opinion that a hen could not lay more than 600 eggs during the course of her life. Should she produce a large number in her first and second years, the ovaries would be rapidly exhausted, and it was thought to be useless keeping her after that time had expired ; if fewer, she might be retained longer. Dr. Raymond Pearl has, however, shown (1) that hens have a much greater capacity than had been known. It is the capability which appears to be deficient. Professor James Dryden, formerly of Oregon, recorded that one of his White Leghorn hens laid 664 eggs in three years—namely, first year, 240 ; second 222 ; third, 202—and that in another case 691 eggs were laid in four years. Dr. Pearl mentions a Leghorn hen with a total of 969 in seven years—namely, 105 ; 163 ; 138 ; 159 ; 160 ; 133 ; and 111, thus averaging 138 eggs per annum. Other cases have been recorded of hens which have produced upwards of a thousand eggs. It will be of interest to see what are the total records of the hens which have exceeded 300 eggs in their first laying year.

The above figures apply to eggs actually produced. Until recent years no data was available as to latent capacity upon which breeders might hope to draw. In the Report of the Main Station referred to, Dr. Pearl records observations made by Miss Maynie R. Curtis as to the number of oöcytes, or ovules, visible to the naked eye, found in fifteen hens killed after laying had commenced, to which were added the number of eggs already produced, the winter production, and the discharged follicles, the latter of which indicate that many oöcytes are formed that do not become completed eggs.

Breed	Date hatched	Date killed	Total Number of Eggs laid in Life.	Winter Production.	Discharged Follicles	Total Visible Oöcytes
Barred Plymouth Rock	June 1	Mar. 28	10	2	17	1,226
,, ,,	,, 2	,, 30	10	0	12	1,666
,, ,,	,, 1	,, 10	7	0	8	914
,, ,,	,, 2	,, 14	17	5	12	1,174
,, ,,	April 28	April 4	34	3	49	2,306
,, ,,	June 2	Mar. 24	10	0	23	1,194
,, ,,	,, 2	,, 24	15	0	17	2,101
,, ,,	May 19	,, 17	19	5	24	1,576
,, ,,	Mar. 30	July 7	22	0	21	1,521
White Leghorn ...	May 18	Dec. 29	198	54	75	2,452
,, ...	,, 28	,, 15	197	32	217	3,605
,, ...	,, 21	,, 13	10	0	11	1,701
,, ...	June 14	,, 22	2	0	43	2,145
Cornish Indian Game	April 21	July 12	52	13	54	1,550
Cross-bred	Mar. 31	Mar. 20	124	106	50	2,000

As will be seen by this table the number of oöcytes in the nine Plymouth Rocks averaged 1,519.77; in the four White Leghorns, 2,475.75; in the Cornish Game, 1,550; and in the cross-bred, 2,000. The variations of individuals in the two leading breeds are, however, very great, indicating that there is no fixity. What is evident is that the latent egg capacity in all these hens was very great.

The observations made by Dr. Pearl were: 'The data now in hand, even at the very lowest valuation which may be placed upon them, indicate that there must be some other factor than the anatomical one involved in the existence of different degrees of actual fecundity of the domestic fowl. It clearly is the case from the table that, when one bird has a winter record of twice what another bird has, it is not because the first has twice as many oöcytes in the ovary. On the contrary it appears that all birds have an anatomical endowment entirely sufficient for a very high degree of fecundity, and, in point of fact, quite equal to that possessed by birds which actually accomplish high records. Whether or not such high fecundity is actually realised evidently depends, then, upon the influence of additional factors beyond the anatomical basis. It is reasonable to suppose that these factors are physiological in nature.'

From what is revealed by the investigations recorded above it is clearly shown that capacity, even in hens which are in practice found

to be low in the scale as layers, is far in excess of the number of fully formed eggs of the most prolific races. Much study is being given to the subject by those engaged in research, from which it may be hoped that further knowledge will be available. In this connection are two most important considerations, namely, first, the effect of stimulation of the ovary leading it to discharge oöcytes at a much increased rate, and beyond the capability of the oviduct and its glands to form into complete eggs, in which case these oöcytes are discharged into the body cavaties causing congestion and, possibly, disease; and, second, whether the physiological influence of accelerated ovarian activity does cause over strain of the oviduct and glands, followed by ovarian affections which are so much more in evidence than was formerly the case. Apart from that, however, any such strain may explain to a considerable extent embryonic and post hatching mortality. The problem which is presented to all who are engaged in egg-production on special lines, in which the maximum of fecundity is of the utmost importance, is, how far the physical capability of the hen is able to meet the demands upon it without breaking down. The danger in this direction arises from the evident fact that fecundity is far in excess of productivity. This may not be apparent in the individual hen. We have no evidence, however, that such will be the case in the progeny, should these birds be used for breeding. The wiser course is to look to the parents of these record hens rather than to the individuals themselves.

Parental Influence.—The practice has been common among farmers and ordinary poultry-keepers of introducing pure-bred male birds among their flocks every season. When carried out systematically the effect was beneficial. Where it failed was that in many cases the males were selected for racial characters rather than inherent productiveness, and that arbitrary changes of breed are frequently guided by fashion or fads. That this system, as a rule, has made for increase of constitutional vigour is unquestionable, provided that both males and their mates are carefully selected. The influence upon fecundity is small. All experience goes to show that the male is more than half the strain, and that he must be looked to for improvement, primarily by reason of the fact that he has not been forced or selected by reason of production as in the case of hens through many generations it may be.

With the greater attention given to eggs as the main source of profit, and the rise of Commercial Poultry Husbandry, the dominance of the male was threatened, if not lost for a time. Everything was centred upon the hen, and her supremacy was accepted, almost without question. This was given great impetus by introduction of the trap-nest. Records obtained in this manner revealed the fact that variability of fecundity was very great even in the same breed and family. Pullets bred from the same parents, at the same time, and reared in the same manner, were found to range to an enormous extent in the number of eggs individually produced, for which there was no apparent reason. It was assumed that elimination of the drones, and breeding from the most prolific, would rapidly advance the average of flocks bred from them. Results, apparently, for a time justified this assumption. Such did not continue, as proved by the experiments conducted over several years at the Maine Experiment Station, and which were so exhaustively examined by Dr. Raymond Pearl. Reaction took place, more especially when operations were on a larger scale. Averages fell to or below the original mean of the race. A fact of great importance is that during the last decade or decade and a half the average production at Laying Trials has shown no advance, even though the records of individual birds are greater in a few instances. Some evidence of this fact is stated in Chapter XIV, Volume I. The prominence given to the performance of a few exceptional individual hens as layers, remarkable as these are, and a great tribute to the breeding and management, has deviated attention from other equally important factors. There has been concentration upon the average productivity which determines the profit that can be secured. Hence it is that the influence of the male is now recognised as much greater than had been accepted for the time being, following upon introduction of the trap-nest. It is undoubtedly true that the male is most potent in respect to coloration of plumage and external characters. That does not mean, however, he can be disregarded in respect to productive qualities. Experience has abundantly shown that the extreme or exceptional individual, in which any quality is developed to an abnormal degree, lacks the power of transmission of this quality to its progeny, and that such as are above yet nearer to the mean of the race are more valuable as breeders. The tendency to regression is a very potent one.

Fecundity and its Development.—Useful though the trap-nest is to indicate which are the more productive hens, its value is strictly limited. Investigations regarding the problem of fecundity are helping towards a clearer understanding of the subject, though far from completion. In this respect Dr. Raymond Pearl led the way at Orono, Maine, U.S.A. The following is a summary of the conclusions arrived at by him :

The record of fecundity of a hen, taken by and of itself alone, gives no definite, reliable indication from which the probable egg-production of her daughters may be predicted. Futhermore, mass selection on the basis of the fecundity records of the females alone, even though long continued and stringent in character, failed completely to produce any steady change in type in the direction of selection.

Fecundity, however, must be inherited, since (1) there are widely distinct and permanent (under ordinary breeding) differences in respect to degree of fecundity between different standard breeds of fowls commonly kept, and (2) a study of pedigree records of poultry at once discovers pedigree lines (in some measure inbred, of course), in each of which a definite, particular degree of fecundity, constantly reappears generation after generation.

High fecundity may be inherited by daughters from their sire, independent of the dam. This is proved by the numerous cases where the same proportion of daughters of high fecundity are produced by the same sire, whether he is mated with dams of low or high fecundity.

High fecundity is not inherited by daughters from their dam. This is proved by a number of distinct and independent lines of evidence.

A low degree of fecundity may be inherited by the daughters from either sire or dam, or both.

Results have shown that, on the average, the daughters of birds laying from 150 to 190 eggs in the year laid much better than the daughters of 200-egg hens. This result is, obviously, of great importance in its relation to the general question of the effect of selection for increased egg-production.

Continued selection of highly fecund females alone could not even be expected to produce a definite and steady increase in average flock production. The gametic constitution of the male plays so important a part in determining the fecundity of the daughters that any scheme of selection which left this out of account was really not systematic at all,

almost altogether haphazard. It has been repeatedly shown that the same proportion of daughters of high fecundity may be obtained from certain mothers of low fecundity as can from those of high fecundity, provided that both sets of mothers are mated to males of the same gametic constitution.

The conclusions arrived at, and now generally adopted, are that the male influence in egg-production is more potent upon immediate progeny than that of the female, and that selection of such male from a family characterised by a high standard of fecundity over several generations is supremely important. Although the mating of a good male as stated with hens of low fecundity may produce good laying pullets in the first generation, that is a risky step to take, if these in turn are to be used for breeding, as the doing so would be calculated to depress the mean of the race. The wise policy is to build up by study of both parents, and by slow stages. A question which has never yet been decided, if ever it can be, is how far environmental factors have contributed towards advancing the average fecundity of poultry. This is a contributory factor of greater influence than is generally recognised.

Application.—It will be evident that the complexity of the questions involved means that the general farmer and poultry-keeper concerned with market production, must leave selective breeding largely in the hands of specialists from whom stock can be obtained as required. Trap-nesting is costly in plant and labour. It is misleading unless it is efficiently carried out. For reasons given below, the general though progressive poultry-keeper will find it enough for his purpose to obtain male birds from reliable breeders who are operating on good lines. These should be sons of dams which have laid 200 to 220 eggs in the pullet year, which eggs were well over 2 ounces each from the first, be active in habit and vigorous in constitution, and of good average size. With these should be mated hens that have proved themselves to be good layers, say, 160 to 180 eggs in the pullet year, and are characterised by all the signs of vigour and health. Under these circumstances there is no need to trap-nest if all pullets which are found to be laying between, say, the 15th of October and the 1st of November, are ringed, so that in the following Autumn selection from these can be made for use the following season as breeders. And,

be it noted, those hens which are longer in commencing to moult after their first season's laying, will be the most valuable for use in the breeding pens, that is, if these have stood the test and retained their vigour. It will generally be found that those who adopt trap-nesting have in view the sale of stock, eggs for hatching, etc. Theirs are breeding plants in which the additional equipment and labour are justified by the higher returns obtained. The comparatively few whose operations are on a sufficiently large scale find it pays to trap-nest a part of their stock. They are their own source of supply. Some of these by adoption of what may be termed mass breeding, that is, the mating of several males with a larger flock of hens, possibly when the last named are being maintained with a view of maximum production, are attempting two things at once, and, as is general, come to the ground between them. What we have to aim for is permanency wherever breeding is involved.

Effect of Early Laying.—Increase of winter production of eggs is of the utmost importance not alone to regularise the supply for market, and to obtain the financial advantage of higher prices prevailing at that season of the year, but also from the fact that the hens which come into profit thus early are those which normally give the highest average over the entire twelve months. In this respect production during the Spring months is no indication of the annual output. The following statistics are taken from one of the English Laying Trials, in which there were 600 birds competing:

Average Egg-Production for Complete Year of Birds commencing to Lay at Different Times.

Birds which laid 10 or more eggs in the first four weeks (October 15 to November 12)	187·5
Birds which laid at all in the first four weeks	167·7
Birds which did not lay in the first four weeks	161·4
Birds which did not lay in first eight weeks (October 15 to December 10)	155·8
Birds which did not lay in the first twelve weeks (October 15 to January 7)	106·5

At a similar competition held in Ireland the results are even more suggestive—namely:

Eight hens which produced an average of 57 eggs in first three months (November, December, and January) averaged in total year	206·00
Eight hens which produced an average of 19·99 eggs in first three months, averaged in total year ...	96·25
Eight hens which produced an average of 1·25 eggs in first three months (6 did not lay at all) averaged in total year	47·88

Other factors, doubtless, had an influence in all these cases. It is evident, however, that the winter laying is indicative of total production, and of the profitability of the birds. The endeavour should be to bring all birds into profit in the late autumn or early winter. In order to do this hatching must be at a time which will allow the birds to grow, and without forcing, so that they will have matured sufficiently to be in profit by October 1st, or soon after that date. Something will depend upon the soil and conditions, for development is more rapid in one environment than in another. As a general rule, subject to modifications, it may be accepted that for the lighter and smaller-bodied breeds, March, April, and to the middle of May, is the best hatching period, and for the heavier bodied and slower growing breeds a month earlier. There has been a tendency in the direction of much earlier hatching, the wisdom of which is very questionable from the breeding or reproductive aspect, though advantageous, perhaps necessary, to secure continuity of supply of eggs for market. An essential factor is to carefully observe the stock bred early, and to eliminate any which appear to be losing in constitutional vigour. Very early hatching is of importance where the object is to produce chickens or ducklings for market. With these no harm can result from the fact that these birds are killed off and not used for breeding.

There are, however, influences which have been revealed as a result of continuous breeding for early and prolific laying, and which indicate that this practice is not wholly beneficial. Experience has abundantly shown that when in a pullet the ovaries reach the active stage, as evidenced by egg-production, there is a check to her growth, which is

slowed down to a marked degree. The more eggs she lays during what may be termed the adolescent stage the greater is this check. Although she may make some increase of weight of body in the next few months there is an arrestment and, generally, a final loss in size of frame. Such is in accordance with natural laws and is due to the fact that the elements which would have been utilised for building up her body are turned into the direction of egg-production. During recent years the reduction in size of breeds and varieties which have been characterised by high fecundity has been very marked indeed. It may be attributed to two causes, both of which are interrelated, namely, that the most prolific layers are usually below the mean of the race in size, and that as these are bred from with the desire to perpetuate this quality, the decrease is more marked in successive generations. And, further, that early egg-production, as already stated, arrests the growth which would otherwise take place, and frequently leads to a loss of constitutional vigour by reason of excessive strain upon the system before the ability to withstand it has been fully developed. We have here an explanation for the small, almost bantamised specimens which are seen in Laying Trials and among the stocks of egg farmers. Even though it is undesirable to seek for large size in chickens intended as layers, there must be maintenance of that which is in conformity with the breed. In some Laying Trials pullets below stated weights are excluded from competition. The same should be adopted by breeders, otherwise the degeneracy indicated will continue at an accelerated pace.

Whilst it is true that some of the smaller-bodied breeds produce large-sized eggs, and that the weights of body and eggs are not correlative, as we have previously seen, it is unquestionable that early laying and high fecundity have led to an increase in the proportion of small eggs. Such is in conformity with Nature. At the same time there is abundant experience to show that by careful selection of eggs for hatching this need not be so to the extent which has hitherto been the case. It is important to recognise, first, that the period of maximum production is not that when the hen is best fitted for reproductive purposes ; second, that no egg should be used for hatching unless it is equal in or slightly above size according to market requirements ; and, third, that full maturity should be attained before a hen is placed

in the breeding pen, which will at the earliest be when she is two years old and over.

Trap-Nests.—We have already indicated that there has been abuse of these appliances by solely relying upon what they have revealed in respect to egg-production. As a means, however, of determining the fecundity of hens, with a view of obtaining the data already referred to, they are valuable. Of these many types are now in use. The principle is the same—namely, the hen enters a nesting box to lay her egg. It is fitted with a trap so that she cannot get out again until released. By the use of leg-rings or bands, each of which are either coloured or numbered, the eggs laid by each individual hen can be credited to her on forms prepared for the purpose. In this way tables can be prepared indicating results of each period and for the entire year. It is necessary to attend to the nests frequently, otherwise the hens which have laid would become restless, and, together with the entering up and analysing the records, a considerable amount of labour is involved. It, however, reveals the facts of the case, and is worth while to the careful breeder, who thus can find guidance as to the breeding operations. Numbers of eggs are too often the sole record taken. It is essential to indicate their size and quality.

Winter Egg-Production.—The normal period for laying eggs is during the Spring and early Summer, which form the natural breeding seasons of the year. Practically all hens are productive at these periods. Profit in this branch, however, is largely determined by the eggs laid in the other months, when prices are much higher. Under ordinary conditions pullets do not commence to lay until after Christmas in the northern hemisphere, with the result that the winter egg demand is missed. The object, therefore, of the egg farmer must be to so organise his operations that the majority, if not all, the pullets will be in profit by October. If that is accomplished, and other influences are favourable, the following year these as hens will resume laying after moulting, much earlier than would otherwise be the case with the later layers. To this end it is essential that hatching shall be early enough to afford time for steady growth to attain the degree of maturity required, and without inducing ovarian activity before this has been reached. In this connection it is impossible to lay down any hard and fast rule. Much depends upon the nature of the breed kept,

the class of soil, the climatic conditions, and the system of rearing. A cold summer means slower development. Upon heavy soils chickens do not grow as quickly as upon lighter lands, and the same is true in the more exposed areas. Each poultry-keeper must experiment with a view to discernment of what is his environment and how this can be used to attain the object in view.

In this respect there are considerations which are commended as contributory, namely:

A sufficient proportion of the stock should consist of pullets, for the reason that these usually commence laying earlier than do the older hens, as the former have not to pass through a moulting period. Hence replacements should be divided between two or three years. At the same time it is recognised that pullets lay smaller eggs than do hens, in some cases very much less. It is of the utmost importance that after the first half dozen eggs those produced should be as near two ounces each as possible.

So far as the older birds are concerned a factor of importance is the time when these moult and cease laying. Some do this in the early or mid-summer, in which case the moult is usually prolonged. The object should be to discover what are termed long-distance layers, that is, those which continue in profit over an extended period, not alone that these give a greater return in the number of eggs laid, but that they thus indicate a high degree of constitutional vigour, and are able to withstand the strain of continuous production. These are especially valuable for use as breeding stock. Many highly fecund pullets break down during or after the laying year, and die exhausted by the process.

In this connection a system has been adopted in America of what is termed Culling, though practiced elsewhere for generations. As is usually the case it has been much overdone, and more claimed for it than has been justified. That, on general farms, there has been retention of hens far beyond the stage of profit, and an absence of selection of those which are built on productive lines, whether that be for eggs or flesh, is found in many countries. Under these conditions Culling is commendable in the extreme, and usually is followed by a much higher percentage of eggs from the remaining stock. Also, with poultry-keepers of all grades, it is desirable to go over the older hens, say, those of two and three years old, in the months of June and July,

selecting such as are not to be kept another season, and sell these even though at the time they be in-lay. At that time of the year larger-bodied birds usually command a better price for consumption than they will at any later time. When we take into consideration the higher returns and the saving of feed, any sacrifice of eggs will be much more than compensated. There is also the additional space for younger stock which will thus be available. To retain the older hens through the moult is non-economic.

It is a totally different matter Culling on egg farms, where all the stock is selected, and older birds are not retained. That the fewer drones there are the greater will be the profit, is evident. Mechanised selection by outward signs such as pigmentation of the legs and beaks in the yellow-fleshed races cannot be depended upon in this respect. Many factors may influence the laying of hens at the season named. Some of the most valuable birds may from various causes cease to be productive. Nature is craving a rest, most of all with those that have been highly fecund during the winter and spring. Many of these would resume after a short interval, and be all the better for it. The drones are those which have failed in production during the two periods named, not such as are taking a summer rest. Short views in this and other respects are a mistake in policy.

Breaking-off Broody Hens.—We have always been opposed to the system, which is very generally adopted, of transferring to what is called a " broody coop " all pullets or hens which evince the sitting instinct. That such practice increases the output is unquestionable. These coops are usually cages with a barred floor so that it is impossible for the birds to squat comfortably, as they are practically perching all the time. Except with very intensive sitters the broodiness passes, and if returned to the flock the hen will resume laying. She is thus denied the rest for which her nature was craving. Where either pullets or hens are kept as layers, with no intention whatever of using these for breeding, no serious harm may ensue. With such as may be mated the following year it is a blunder, and may be responsible for the ever-increasing losses from egg, chick and adult mortality which have marked recent decades. Nor is the system profitable to the extent generally supposed, first, by reason of the fact that if the birds are permitted to follow the natural instinct at a time when eggs are cheap,

and hatch a brood, the chicks will be fit for sale at a time when they command a good price, and she will recommence laying during the period of greater scarcity of eggs when these will realise more than would have been the case earlier on. Most of all, she will have thus stored up vigour which would otherwise have been lost. This is another example of seeking for immediate results without regard to the future.

Laying Sheds.—Wherever egg-production is made a leading feature, whether on general farms or specialist plants, there should be provided accommodation for the hens in winter, such as the scratching-sheds described in Chapter XXII. No satisfactory explanation has been forthcoming as to why hens will yield a higher average of eggs during the season named, even in flocks up to one hundred and fifty, than if divided and scattered about the land. The fact nevertheless remains. This is not only true in the countries where the winter conditions are most severe, and it is necessary to afford protection against the elements, although there of the greater importance. It is also the experience in countries and districts where such provision does not appear necessary. Although the costs of these forms of houses may appear high, as an investment they are more than warranted by the enhanced returns of eggs in the best paying season. If used in this way from September to February or March, such a building will be available for other purposes afterwards, for early broods of chickens, fattening surplus birds, etc.

Illuminating Poultry Houses.—As explained in Chapter XXII, at one time it was generally thought that the reason why hens lay more eggs in the Spring and Summer months than in Autumn and Winter, is due to higher temperature during the former periods. Hence the trials given to application of artificial heat. It has now been found that a totally different influence is responsible, namely, that during the shorter days and longer nights the birds are unable to obtain and retain sufficient food to provide the surplus from which eggs are made. Through the hours of darkness they are consumers rather than producers. Unless, therefore, an opportunity is afforded of replenishing the exhausted stores they are living on their own resources. It is, therefore, food, not heat, that is required.

The modern system of artificial lighting to promote winter egg-

production is due to the discovery by Mr. G. R. Shoup, of the West Washington, U.S.A., Agricultural Experiment Station, practically by an accident. It is, however, of interest to record that the illumination of poultry for this purpose was practiced in Spain between one and two centuries ago, as described in a book published in that country in 1802. That does not in any way detract from Mr. Shoup's contribution to the progress of later days. It is found that by this means the winter production of eggs is considerably increased, though not the annual output, as there is usually a reduction in the Spring following. Experience has revealed the fact that for highly fecund stock which has been bred and raised for winter laying, the gain is by no means so marked, and also that it is not successful with breeding stock, as the hatchability of the eggs, and the rearability of the chickens, are adversely affected. It has also been found valuable for promoting the growth of backward chickens during the Autumn or Fall months of the year. One important point requires to be emphasised, namely, that in many instances pullets which have been lighted their first year are less productive in their second season. This is important as it indicates that the system imposes a strain upon the body and its functions, and that such birds are generally found to be undesirable for breeding. This is a further example of the limitations imposed by Mother Nature. It would appear that lighting of houses for winter egg-production is of greater value to the ordinary egg farmer than to anyone who adopts more intensive methods, or to the owners of Breeding Farms. What is to be guarded against is the abuse, not the use.

Almost any form of lamp can be used for this purpose. Where electric light is available that is the most convenient illuminant, in that by installation of an automatic apparatus for turning on, dimming, and extinguishing the light the need for personal attention is obviated. For this purpose a 40-watt lamp is ample to illuminate the floor space as stated below. A powerful oil lamp, or an apparatus for acyteline gas may, under other conditions, be employed with equal success. These, however, require more attention. The lamp should be fixed 6 feet above the floor, and will, if provided with a 15 inch cone reflector, effectively light up about 200 square feet of floor space. In a large house lights should be placed at intervals of 10 feet, or in accordance with the experience gained.

Much harm has been wrought by continuing the light over too long a period, and many failures have resulted as a consequence. This must be avoided. As the time of maximum laying is usually April, the conditions prevailing at the beginning of that month in respect to light are found to be a safe guide. As a rule in those countries where this system is most needed it is found that on April 1st, there is about 13 hours daylight and 11 hours darkness. Lights do not appear to be of service before October and after March 15th as the duration of day is nearly as stated.

Generally speaking the aim should be to continue the duration of sufficient light to enable the birds to feed from 6 a.m. to 7 p.m. At the former hour the lamps should be turned on, and be turned out when it is fully day. When twilight is coming on in the afternoon the process should be repeated. This will vary considerably during the winter months. As 7 o'clock approaches the lights should first be dimmed, although many of the birds will have gone to roost when their crops are filled, and a little later be turned entirely off.

When first using the lights the attendant should see that the birds have gone to their perches after feeding. After a few days they will do so as a matter of course.

As a rule when introducing lights it is sufficient for these to be used only in the evening. With the later rising of the sun illumination in the morning is desirable. In March when the sun rises about 6 o'clock this is not required and may be dispensed with, continuing the evening lights for a couple of weeks later. The discarding of these should be gradual.

The object is to continue the feeding over a longer period than the duration of daylight permits. Therefore, grain should be scattered in the litter so as to induce exercise, and the mash boxes, where dry mash is fed, should be available to them.

The application of this system is, as already stated, not so successful with breeding stock and highly fecund layers as with others of a more general class. A large amount of study has been given to this subject at Cornell University and elsewhere. With regard to the effect upon hens intended for stock Profs. Rice and Botsford say (2): 'A great mistake which is made too often is that of allowing the high-producing birds to continue in production until but a short time before the

hatching season, or, even, in some cases, right through without a stop. The desire of the owner for eggs at that season of the year must not take precedence over the natural laws of reproduction, which demand that breeders be allowed a rest of several weeks or months, in order that good fertility, hatchability, and vigour of chicks may be secured. Breeders, therefore, should be thrown out of production at least two months before the breeding season, either by reducing the amount of artificial illumination they are receiving in the fall, by changing their quarters, by feeding heavily on grain in the morning, or by combination of the above methods.'

The costs of installation and maintenance of lights vary considerably in accordance with the system adopted. All the evidence obtainable is to the effect that, where applied to the degree indicated above, these are repaid manifold by the higher prices obtained for eggs in the winter as compared with the spring.

Profit Obtainable.—When eggs were much lower in price, and the average production was an uncertain factor, mainly seasonal, that is, when production was general, there was every justification for regarding poultry farming as unprofitable. It was merely a side issue and on a non-economic basis. The changes which have been brought about in these directions, together with the rapid advance in demand for eggs in almost every country, have resulted in Poultry Husbandry now occupying a totally different position and one which is providing an entire or partial livelihood to large numbers of earnest workers. In this connection much depends upon economy in feeding and in management. Frequently statistics published are from small poultry-keepers, whose households supply a considerable part of the food required, or, on the other hand, from those who feed expensively, with whom it is a hobby rather than a commercial pursuit. Evidence shows that where operations are conducted upon a sufficiently large scale, where the fowls are permitted to forage for part of their feed, and other supplies are purchased in quantity and fed judiciously, a flock of hens can be maintained at an annual cost of 6s. to 8s. (say, 1 dollar 50 cents to 2 dollars) per annum. Whatever is expended beyond that amount should be carefully checked.

It is generally accepted that food represents two-thirds the costs of production, and that the additional one-third should meet overhead

expenses, inclusive of interest on capital, replacements and renewals of plant, incidentals, and, in the case of larger operations, employed labour, though the last named is an uncertain quantity varying considerably. In this is not regarded the owner's labour, as that is provided for by the profit which may be made. On one-man plants the profit is usually higher for obvious reasons. Whilst farmers, by reason of lower feed and other costs, can secure a modest profit on the basis of 70 to 80 eggs per hen per annum, and less if there is a good outlet for chickens, the egg farmer must obtain an average of 100 per annum to meet his charges. Therefore, under these circumstances, making allowance for increased food consumption as the egg average increases, with an average of 120 eggs per annum, there should be a profit of 3s. (75 cents) with 140 eggs 5s. 6d. (1 dollar, 32 cents), and with 160 eggs average 7s. 6d. (1 dollar, 80 cents) should be realised. Under specially favourable conditions for marketing, these profits can be increased. The costs of sale and distribution in the main are the charge of the producer.

One important item is not, however, calculated in the above, namely, replacement of stock. This is more expensive with the lighter-bodied races from the fact that the surplus chickens and old hens do not command the same prices on markets as in the case of heavier-bodied fowls. That explains the reason why farmers, as a rule, prefer the last named. Even with the former much can be done to improve the edible value of young birds which have to be disposed of by a system of feeding off. Where this has been carried out systematically it has been found possible to create a demand for small birds at paying prices. Too often, however, the markets are flooded with cockerels on which there is very little flesh. With a class of stock which are higher in meat properties the costs of replacements, except any fresh blood which may be introduced, is not a serious factor. Something, however, depends upon the length of time the hens are retained, in which is involved the provision of equipment for hatching and rearing whether by natural or artificial methods. There is also the question as to whether the laying hens are retained for two or three seasons. Upon a farm whereon are maintained a thousand laying hens, if the practice is that these are disposed of after the second season, there should be at least 600 pullets available for replacement annually to allow a margin for mortality and elimination of low producers, so that

it would be necessary to hatch 1,200 to 1,500 chickens, allowing the usual percentage of cockerels and wasters. Should the three year method be adopted, 400 pullets would be needed annually, and 800 to 1,000 chickens be hatched. In many instances it has been found, and especially with the more fleshy races, that, taking into consideration the sums realised for sale of cockerels and old hens, the costs of replacements are met, except interest on equipment for hatching and rearing.

Crosses for Egg-Production.—In respect to those breeds of fowls in which the male chickens are of small value by reason of lack of flesh, many attempts have been made to discover, or control, the sex at hatching. If that were possible it was suggested that the economical method would be to kill the cockerels at once, and that the expenditure for eggs and hatching would be more than compensated by the saving of feed, labour and apparatus. Such appears to be most wasteful, and is due to lack of effective organisation or to selection of unsuitable birds. The test, however, is in the comparative results.

Where the entire object is to produce supplies for market by adoption of commercial methods, there is a growing tendency to use of crosses rather than pure breeds, for the reason that the former are regarded as hardier and more productive than the last named. That this is justified has been proved by long experience. In fact it explains why crosses upon farms was at one time the general rule, even though the birds were usually mongrels and low in production. As an indication of what is here stated may be quoted observations made by Mr. D. C. Warren at the Kansas State Agriculture College (3), in which comparisons were made between pure Jersey Black Giant Fowls, pure White Leghorns, and crosses between these two breeds. The results were as follows:

	Jersey Black Giants	White Leghorns	Hybrids
Egg-production	162·3	173·8	212·9
Percentage of hatchability ...	57·2	73·2	77·8
do. of chick mortality ...	19·9	12·2	3·2

These figures are in conformity with wide experience over a long period, as is also the fact stated in the report mentioned, namely, that 'succeeding generations of this cross,' by which is evidently meant

that the cross-bred birds were used for breeding, 'did not show vigour equal to the F1. generation.' Therefore, although the gain is considerable in the first cross, in order to maintain this it is necessary to discard the crosses entirely for breeding, and keep separate pens with pure males and pure females. Under such system selective breeding can only be adopted to a very limited extent, and the possibility of developing the inheritance of fecundity is sacrificed. When we balance the gains and losses, all the weight of evidence is in favour of the pure races by reason of their greater prepotency, provided that these are mated and reared on natural lines, and that undue weight is not accorded to any one factor such as number of eggs regardless of other considerations. A further point is that the skill of the breeder, should this result in the development of a stock characterised by high fecundity cannot find an outlet for his surplus birds by sale as breeders, and for which much better prices can be obtained. Cross-bred males and females do not sell for more than a third or half what is realised for pure stock. Those who desire to adopt crosses for egg-production are referred to the section on Sex-linked crosses in Chapter XIV, Vol. I.

Size of Eggs.—The question as to market standards for eggs is dealt with in Chapter XX. The point for consideration at this stage is whether anything can be done to improve the size of eggs where these are below those which are generally accepted. Some breeds of fowls lay large eggs, notably, the Minorca, Andalusian, Dorking, and Scotch Grey, with some of which if anything the eggs are too large. On the other hand there are breeds which lay small eggs, although very prolific, of which the Hamburgh is a leading example. At one time this was the chief fault of the Wyandotte. That, however, has been remedied to a considerable extent. The majority of the more popular races of fowls produce eggs which meet the market standards, with a tendency to diminution in size which has been more and more evident by reason of the constant striving to enhance fecundity. It is an undoubted fact that the breeds which have been most prominent as winners in Laying Trials are those in which the loss of weight in eggs is most apparent. That this need not be so is indicated by the notable exceptions in which high production and size of eggs have been maintained.

It is possible to modify the size of egg with every breed in a forward

or backward direction, by selection of the eggs for hatching. The process is, therefore, within the power of all breeders. It can be realised that if, in order to secure early chickens or for any other reason, eggs are used for hatching just as they are laid by the pullets, and these be small, the tendency to small eggs is being perpetuated as the hens which lay small eggs are being used for breeding. It ought to be a rigid rule with every breeder never to set or sell for setting an abnormally large or a small egg, unless it is intended to kill at an early age the chicken which may come from it. An egg equal to the standard, even a fraction over, for increasing the size of egg must be done gradually, should always be used. That means it is of the utmost importance the selection of suitable eggs for hatching should be adopted so as to counteract the tendency to decrease in size which appears to be constantly at work. In this connection should be remembered that eggs of Jungle fowls are considerably below what is general under domestication, and that reversion, or "pull-back" as it is sometimes called, has to be reckoned with. The practice of hatching chickens from young pullets has the effect of reducing the size of eggs. Hence the necessity for breeding stock on both sides having attained maturity. These should not be less than eighteen months old.

Colour of Shells.—There is considerable variation in the coloration of the shells of eggs laid by hens, ranging from dead white to deep brown; in those of ducks from a glareous white to green; in those of geese a pale green; and in turkeys a speckled brown. It would appear that in the case of hens their eggs are originally brown or deeply tinted, and that the loss of colour is due to domestication, which is supported by the fact that as the number of eggs produced by hens which lay those with brown shells increases the density of coloration decreases. So far as known there is no relationship of quality in the eggs with the colour of the shell, and that those with white-shells produced under the best conditions are as nutritive as are the eggs with tinted or coloured shells. The one point which is of interest is that those races of fowls which lay brown-shelled eggs are naturally the better winter layers, that is, apart from selective breeding with that object in view. In this respect there is considerable difference in market demands, and without any apparent justification. There are districts where a strong preference is evinced for brown-shelled eggs,

and *vice versa*, in each of which those which are in compliance will command the best prices if size and quality are equal. There can be no question that where eggs in shell are placed on the breakfast table, nicely tinted eggs look better in a silver stand than do those with white shells.

The breeds which produce tinted-shelled eggs are without exception sitters, although there are other breeds which evince the maternal instinct that lay white-shelled eggs. Where hens of a breed which normally produce white-shelled eggs lay those that are tinted, it is assumed that at some period there has been introduced alien blood, although it may possibly be due to reversion.

PRESERVATION OF EGGS.

In the early years of the Nineteenth Century the first recorded patent was taken out for a process of preserving eggs—the Jayne method of lime water, which is still largely used. Since that time a multitude of other systems have been brought forward, some of which have proved successful. Others, even though these were effective proved commercially impracticable, whilst still more were too expensive, or involved an undue amount of labour, and gave no better results. Unless winter production can be advanced adequately with consumption in the scarcer months of the year, which is never likely to be the case, preserved eggs are necessary, otherwise the prices of eggs from September to January would be prohibitive to the vast majority of people.

Object of Preservation.—This is to carry surplus supplies from the plentiful to the scarce periods of the year, from the cheap to the dear seasons, and in this way to obtain the higher rates which prevail in the last named. The spring and early summer has been, and always will be the period of maximum production, as that is the natural breeding and hatching season. As Poultry Husbandry becomes more general, and average production of eggs is advanced, there is an increase in the spring surplus. By preservation not only are higher prices secured for eggs in the autumn and winter, but the spring prices are steadied by keeping from the market supplies in excess of what can be readily absorbed. Experience in all countries has indicated that preservation is essential to successful Poultry Husbandry. As stated by the Author (4) in Denmark, ' not only is the

trade in preserved eggs profitable in itself, but, by relieving the glut during the spring, those sold at that season of the year command much better prices than if forty to fifty millions more Danish eggs were placed on the market. No greater contribution has been made to the success of Poultry Husbandry than by the introduction of preservation of eggs by whatever process may be adopted. As a rule it is carried out not by the individual poultry keepers but by firms and companies at central establishments.

Who Should Preserve?—The greater volume of preserved eggs are held by private traders, companies, or co-operative societies, who purchase supplies during the spring months as a speculation, store these, and sell at such time as they find it profitable to do so. That the benefits to producers have been and are very great is apparent. Enhanced demand prevents the markets being glutted when supplies are at the maximum, and the slump in values which would otherwise take place every year. As already indicated, increase in Poultry Husbandry cannot fail to make greater the danger of saturation during several weeks of the year. That has been reached in several producing countries and districts where the local consumption is incapable of absorbing all the spring production, and where profitable markets unaffected in this way are not within reach. There is, however, an exception to what is here stated, namely, that countries south of the Equator which ship to European markets thus find a profitable outlet immediately, owing to the fact that their maximum production is when, north of that line, it is the time of scarcity.

Where there are, within easy reach, consuming areas in which there is a satisfactory demand for the best qualities of preserved eggs during the autumn and winter months, egg farmers who are operating on a fairly extensive scale will find it a profitable investment to arrange preservation on their own plants, even though it means the locking up of capital for six months. For those who operate on a smaller scale, or where the markets are more distant, some form of concentration is essential. Under favourable conditions, of which Denmark and the Petaluma district of California are examples, co-operation has undertaken the responsibility, and with a large measure of success. In this manner the eggs can be collected and subjected to the process within a short time after they are laid, and, as a consequence, are of a higher

quality than would otherwise be the case when commencement of the process is delayed. Condition of preserved eggs depends to a considerable extent upon the method adopted. Other things being equal the shorter the time between laying and that of preservation, the better these will be when the time of sale arrives. Observations over wide areas in Europe and America have revealed that frequently eggs are from ten to twenty days old when cold stored or pickled, under which circumstances these are of a lower quality, even though for cooking such eggs form an important part of food supplies during the periods of scarcity.

When to Preserve.—Much depends upon the time of year when the eggs are put down. It is a fortunate circumstance that the period of maximum production is when eggs are capable of most effective preservation. It is largely a question of surplus. The wise policy is to sell whenever a reasonable and profitable price can be secured. Apart from the question of price, it is useless entailing the trouble and expense of preservation unless the spring returns for such as are sold for consumption are improved, and the returns when eggs are sold cover the costs and leave an adequate margin of profit. The best season for preservation is from the middle of March and during April and May, as eggs laid during this period keep much better than those obtained either before or after. Summer eggs do not keep nearly so well, even though the period of preservation be much shorter. The reason for this is unknown. It may be that the higher temperature prevailing affects the contents to a greater extent than is the case earlier. Prior to the middle of March, and from June onwards, prices do not usually promise a satisfactory profit.

What to Preserve.—Whilst it is not to be expected that eggs will retain their pristine freshness after several months, no matter what may be the system of preservation adopted, they form a valuable food supply during the scarce period of the year. The final value, so far as quality is concerned, depends largely upon the method of preservation adopted, upon the conditions under which the eggs are kept during the entire period, and on their treatment after they are brought forward for sale. However well designed these may be, failure must result unless, when subjected to the process, eggs are of first-rate quality. This fact is often disregarded by producers and traders

operating on a smaller scale. A newly-laid egg, provided the conditions are favourable, should be excellent for cooking six months later, whereas an egg several days old will emerge with even a greater loss, and, therefore, be much inferior in quality. A stale egg may be unfit for food. Hence it is all-important that eggs selected for this purpose shall be full, strong in the shell, well formed, and sound. The slightest flaw or crack in shell will be fatal. Every egg should be carefully tested before it is preserved, and all those which do not grade as new-laids be sold for immediate consumption. In this respect there is much need for selection.

For at least 2,000 years it has been known that infertile eggs do not deteriorate as quickly as those which contain a living germ. This is one of the advantages of segregating laying hens and keeping these without males. Upon specialised egg farms that system is now very generally adopted, with the result that there has been a considerable improvement of the keeping qualities of eggs produced under these conditions. It is by no means uncommon to see sterile eggs advertised and offered for sale. The main difficulty is in the case of general farmers where the flocks are on range, and it is thought desirable to run a male with them. Wherever possible, arrangements should be made so that such eggs as are preserved should be infertile, as by so doing a considerable amount of wastage would be avoided. To some extent it is a question of cost. Unless and until buyers of eggs for preservation are prepared to pay more for those which are sterile it is doubtful whether such system would be warranted.

Where to Preserve.—From the fact that the eggs have to be kept through the hotter months of the year it is essential that consideration be given to the conditions where the process is carried out. A direction in which cold-storage has a great advantage is that the temperature can be regulated. Under other systems it is found that well-ventilated cellars, either entirely or partially underground, and with any windows on the north or north-west sides, so that the sun's rays may not enter, are most suitable for this purpose. These cellars are largely employed in Europe, whereas in America cold-storage is almost universal. In the former eggs are usually contained in tanks below the level of the outside ground, holding from 40,000 to 70,000. The last named are about 10 feet square and 5 feet in depth. Where operations are on a

more limited scale, galvanised tanks, or casks, can be used. These are quickly filled, and need not be disturbed until the time is reached for sale. They should be kept in a temperature of not more than 40° F. The higher the temperature the more rapid is the change of contents.

One of the chief difficulties which arises in connection with the preservation of eggs is due to bacterial and mould infection, the former of which is animal and the latter vegetable. From the fact that the shell of an egg is permeable, and that some of the minute forms of life can find access, it is possible that bacterial infection may take place prior to or during the process. It is generally recognised, however, that the cause is pre-natal and that the hen is responsible. Moulds are thought to be caused by dampness, and hence the cellars should be dry except in the tanks.

Methods.—1. *Buttering.*—Smaller poultry-keepers who retain the eggs for a few weeks for home consumption, find it enough to butter them—that is, rub a small quantity of fresh butter over the shell, and store in ware jars or pots in a cool place. Glycerine or any sweet fat may be used for the purpose. The shell must be coated and the pores filled.

2.—*Lime Water.*—The oldest known method, and that which is most general in Europe, is by saturation of eggs in lime water. It is the process which is the least expensive. Although the shells are hardened by lime deposited upon them, that is an advantage in that on removal from the tanks the contents do not deteriorate rapidly, and, further, these eggs are easily distinguished as "pickled," as they are called. The solution is formed by mixing freshly slaked lime with water—say, one to two pounds of lime to five gallons of water, stirring the mixture two or three times per diem, until the whole forms a milky fluid, when a pound of salt is added to the above quantity. After allowing it to stand a few hours to settle and clear, the liquid is poured into the vats or tanks or tubs, which are then ready for the eggs.

The virtue of the lime, as of the silicate of soda referred to below, is to sterilise the water, killing all life, which remains sweet and pure. The quantity of liquid required is not so great as might be imagined. The tank should be about a quarter full at first, adding more as required. The eggs should not be stored more than 4 inches from the top, and be entirely covered with the fluid, which forms a skin or film,

and prevents dust or dirt reaching the eggs. In many cases boards are fitted to cover the tanks.

3. *Water Glass.*—The system which is most generally adopted for smaller operations is by the use of what is popularly known as "Water Glass," which is a solution of silicate of soda, discovered by a German chemist. The results are quite equal to lime water, without thickening or roughing the shells to the same extent. The eggs come out of the fluid clean and fresh-looking. The solution is generally sold of full strength, and a five per cent mixture is found sufficient, namely, 5 per cent of water glass to 95 per cent of water. The latter should be pure, and preferably boiled, mixed when hot, but allowed to become quite cold before use. A stronger solution than that named affects the flavour of the eggs. This method is more expensive than lime water. The cost when larger quantities are purchased is from 1s. to 1s. 6d. (25 to 37½ cents) per thousand eggs. Lime water in many districts does not cost more than 1½d. to 2d. (3 to 4 cents) per thousand, plus in both cases equipment and labour.

4. *Cold Storage.*—In America this system is almost universal. It is in the hands of great firms and companies who have erected huge plants wherein the eggs are stored in cases. Some of these hold many thousands of cases, that is, millions of eggs, either purchased as a speculation or stored at fixed rates for others who take the entire risk. The most satisfactory temperature at which to keep the eggs is 29° to 30° F. It is necessary to arrange for a constant supply of pure, fairly dry air. When removed the general practice is to move from one room to another, each slightly warmer than the other. To transfer rapidly from the chamber in which storage takes place to the ordinary temperature would induce rapid deterioration. The main difficulties which have had to be overcome in connection with this process are the formation of moulds, and that with cold stored eggs, unless great care is taken in the final stage, the loss of quality is very rapid. When used at once eggs which were new-laid when placed in the chambers are very good indeed. It is in the final distribution that much loss arises.

5. *Other Methods.*—The test of all systems is not only accomplishment of the purpose in view but whether it is commercial and practical. During the last generation many methods have been

brought forward which failed for that reason. Proprietory preparations are often expensive. Some have involved the purchase of costly apparatus, or for which a royalty had to be paid.

When lime water or water glass is used, the tanks can be emptied rapidly by use of a perforated scoop with turned edges. The liquid acts as a buffer, preventing breakages if handled gently. Operators should use india rubber gloves and gauntlets to protect the hands. As the eggs are taken out these should be well washed in running water, and placed upon wire basket trays, which may be stacked after draining, and if in a good current of air will soon become dry. Before packing these should be rigidly tested to eliminate any which are bad or doubtful. All preserved eggs should be sold as such.

How Long to Keep.—As indicated above the period for sale of preserved eggs is from September to January. If kept longer, especially with water glass, there is a rapid loss of nutritive quality. Eggs in cold storage are sometimes held over, if prices are unfavourable, from one year to another. That is undesirable in every way and should never be adopted.

Infection of Eggs.—Modern systems of preservation, more especially cold storage, have revealed moulds and bacteria. The most serious are those known as " red rots " and " black rots," the former of which appear to be the result of exposure to cold and damp, such as a wet nest, and to bacterial penetration of the shell. It is very contagious, one egg so affected communicating the taint to others. Black-rot is thought to be due to ovarian or embryonic disease. All eggs should be tested in strong light before preservation, and any which are not perfectly clear be rejected. Testing should also take place before sale.

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CHAPTER XXIX

PRODUCTION OF TABLE POULTRY.

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THE FATTENING INDUSTRY—THE METHOD OF RIPENING—CAGES—SHEDS—CRAMMING—FOOD FOR FATTENING—USE OF MILK—FEEDING—FEATHERS AND MANURE—KILLING FOWLS—DISLOCATION OF THE NECK—SHAPING—STUBBING—PACKING—CAPONISING—DRESSING AND TRUSSING—MILK CHICKENS OR PETITS POUSSINS—SPRING CHICKENS—WINTER FOWLS.

Since the first domestication of fowls and other poultry, the primary object has, throughout the ages, been to use their flesh for food of mankind. Although in all countries the consumption of eggs has taken place, it is only within comparatively recent years that these have occupied the premier position. So great is the change thus brought about, that in actual value the yearly consumption of eggs is several times that of poultry. The object in formation of eggs is essentially for reproduction, as a result of which they are seasonal, and naturally are only available for a comparative short period of the year. On the other hand, by small size of fowls and ducks and by their rapidity of growth, the season for consumption of poultry meat is much extended. Hence it is that in older books dealing with this subject, there is very little stated with regard to eggs, and nearly all attention was concentrated upon flesh, the demand for which was fairly constant. As a result, for several centuries in some counties and areas, there has been a measure of specialisation in raising chickens, etc. In this respect, also, as a result of climate and soil, races of poultry have been evolved which are characterised by high meat qualities. This has been true in several parts of Asia and of Europe for milleniums of time. In the United Kingdom are districts which have been famous for their chickens or ducks or other poultry, and that is generally the case on the continent of Europe. In America this has been so to a more limited extent until more recent days.

Reference has been made in Chapter XVII to the influences of climate and soil, which have largely determined specialised table poultry production in given areas, although market demands have also had their influence. With the growth of egg farming, or of increase of those breeds which are characterised by that quality and are smaller in body, there has been a great increase in supplies of birds which either, by reason of small size or of poor class of meat, are inferior in quality. These present considerable difficulty. Very often the markets are flooded with birds which command a merely nominal price. Much can be done to improve these by special feeding before they are killed, but they can never attain a high standard of flesh qualities.

The Fattening Industry.—The present chapter is written almost entirely with a view of explaining how the better qualities of table fowls may be produced. The information is mainly based on English practice with some reference to experience in other lands. It may be explained that fattening is intended to augment the quantity and improve the quality of flesh for human consumption. It is, therefore, an economic process. To kill a bird in lean condition is wasteful in the extreme. Fattening is the application to poultry of the principles which are adopted in connection with larger stock, namely, that an animal or bird should be fed off prior to killing, the results of which are indicated above. With respect to chickens and fowls, in three weeks from 1 to 3 lbs can be added to the weight, mainly of the edible flesh in accordance with the size and capacity for development. Improvement in softness and quality of the meat and of general appearance is also considerable. It may be explained that fowls are, under natural circumstances, in the best condition for eating when from 12 to 18 weeks old, that is just prior to the time of what may be termed puberty. When that has once passed, they do not come into first class condition again until they are in the neighbourhood of six to seven months old in accordance with the breed. Even then, however, the system of fattening makes for great improvement. An interesting fact is that when this system was adopted in America and Russia, the position and value of birds from those countries was enormously enhanced on English and other markets.

So far as our observations have extended, there is much more of what may be termed individual fattening in France than in any

other country, although elsewhere have been many instances of farmers' wives who were skilful at the business. Some of the finest specimens we have ever seen were produced under these conditions. As a rule, however, the work of rearing is generally disassociated from fattening. The former is carried out upon the farms and small occupations when the birds are sold to collectors for plants where the final stage of fattening takes place as are that of killing and marketing. In some parts of France, Belgium and Great Britain there is a regular system of collection for fattening and in the latter the plants are usually upon a moderate scale. The work, however, is carried out under conditions which are favourable in every way and the operators are generally highly skilled. It is under these conditions where the finest table poultry are produced in all countries. Within recent years on the continent of Europe and in America there have been established great fattening plants, in some of which scores of thousands of birds are undergoing the process at one time. Such may be profitable to those responsible for this development, but it does not tend to maintain, much less increase, the quality of table poultry. There is no doubt about it that mass production in all directions is followed by loss of quality, and that the finest birds emanate from those plants where operations are on a more modest scale. In a comparatively few cases is there an attempt to combine the work of breeding, raising and fattening. Except where the last named is merely for the purpose of improving the food value of surplus stock, central plants yield the best results. What may be termed the dual system has great advantages. Those who raise the birds usually obtain much better prices than would be possible if each had to find buyers, and the fatteners are able to organise a better, larger and more regular supply. This work of fattening is highly specialised, requiring considerable skill and experience.

The Method of Ripening.—The process of fattening is in conformity with what may be regarded as a law of nature. It is practically a system of ripening. At those periods of the year when poultry are in the best and plumpest condition, it is found that there is more fat or oil upon the various tissues of the body than at other seasons, which has the effect of softening and making the flesh more tender. The artificial system, therefore, is an endeavour to reproduce at other

periods the same condition. We know that fruits fill out and are plumpest and sweetest when they are ripe. Here may be explained that flesh which has an adequate supply of fat or oil is finer when roasted for human food, due to the fact that the fat or oil melts and keeps the tissues soft. If in lean condition, the moisture evaporates and, as a consequence, the meat is dry and hard. It is necessary to remember, that ripening, if continued too long, tends to decay. That, however, is proved by the facts already stated, and as an indication that the meat is in the condition at which it will be most palatable and nutritious. Fattening is only applied to poultry that are destined to immediate slaughter. They should be killed as soon as the process of ripening has been completed, otherwise the fatty deposits upon the tissues and organs prevent these functioning properly and may result in disease. The great chemist Liebig was accustomed to say that all fat is a disease. Such statement had reference to human beings. Although breeders and layers should be kept in lean, hard condition, and any excess of fat should be avoided, the dictum of the great German must not be regarded as applicable to table poultry.

There are other considerations of importance, first, that the food supplied shall tend to increase the quality of flesh ; and, second, that the conditions under which the fowls are kept shall be favourable and conducive to success. Although the term fattening is employed, that does not mean merely the laying on of an excessive quantity of fat or oil. The main function of these is to soften and ripen the flesh. Professor Warington, F.R.S. has called attention to the fact that the rates of consumption and of increase vary considerably in different parts of the process. As a fattening animal increases in size, the quantity of food it consumes also increases somewhat and the stomach at the same time becomes larger. When the animals become very fat, the consumption of food falls off again, and the rate of increase at this stage is much diminished. As fattening advances the daily increase in live weight becomes gradually smaller and the same amount of food will produce a steadily diminished amount of increase. (1)

Cages.*—In Western Europe, and especially where favourable conditions prevail, it is customary during the milder months of the year to cage the birds partly and sometimes wholly outside where they can be protected from wind and rain, usually under the lea of

*Plate XCI.

Range of Outside Fattening Cages in Sussex, England

Shaping Sussex Chickens

hedgerows. In the Uckfield district of Sussex and in Kent where a large amount of fruit is grown, the orchards are utilised for the accommodation of outside fattening cages. Where the conditions are more rigorous, and during the colder months of the year, these are not employed. In several parts of Europe and almost universally in America, the cages are all the time in sheds. These outside pens or cages, as in fact those used inside also, are very simply made, consisting of lathes of wood, generally about 1 inch wide and 1½ inches apart, excepting the bottoms which have the lathes narrowed below so that the droppings shall fall through to a greater extent. Each cage should be 7 feet 6 inches long, 20 inches from back to front and the same in height, dividing by lathes into compartments of 30 inches holding 3 or 4 birds. To each compartment is fitted in front a sliding door. Where the cages are used in the open it is customary to make these a little higher in front than stated, with a sloping roof which carries off any rain that may fall. In the best fattening districts of Europe, cages are in single tier raised about 3 feet above the ground, standing upon what are called stages, that is pieces of scantling supported by posts fixed in the ground. Cages are movable to facilitate cleaning.

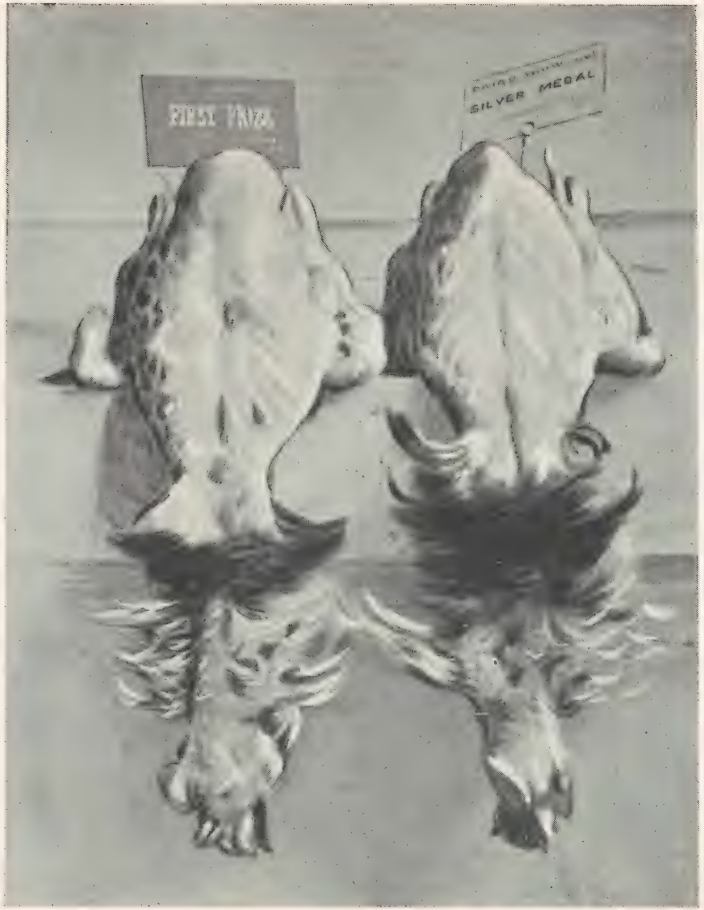
In some of the larger fattening plants in Europe and notably so in America, blocks of cages or batteries as they are called are built, generally in three or four tiers. These are economical of space. In some buildings which we have visited a very large number of birds were accommodated at one time. Under such conditions, whilst every care may be taken to keep the cages clean, the system cannot be regarded as altogether satisfactory. No doubt the higher quality of birds and meat produced where the operations are on a smaller scale, is due in some measure to superior races of fowls. That, however, is not everything. The conclusion arrived at, and which appears to be justified, is that by the use of single tiers the birds obtain a more regular and abundant supply of fresh air. Where there are several tiers under the battery system the atmosphere in which the fowls are living cannot be as sweet, and circulation is impeded. Whereas with the single tier system, there is no side to the cage, which together with the top and bottom, facilitate complete atmospheric circulation. Economy of space is dearly purchased if neglected.

In many of the most successful fattening plants everything is of the simplest and cheapest description. The opportunity is taken of the slack seasons to put together what further cages are likely to be required, either for renewal or extension of operations. It is customary in these cages, whether used outside or under cover, to suspend by cords in front a long wooden trough, made V-shaped or rest it upon supports. In either case these are easily removed for cleaning. An exception, however, is during the process of cramming, as described later, when these troughs are not required.

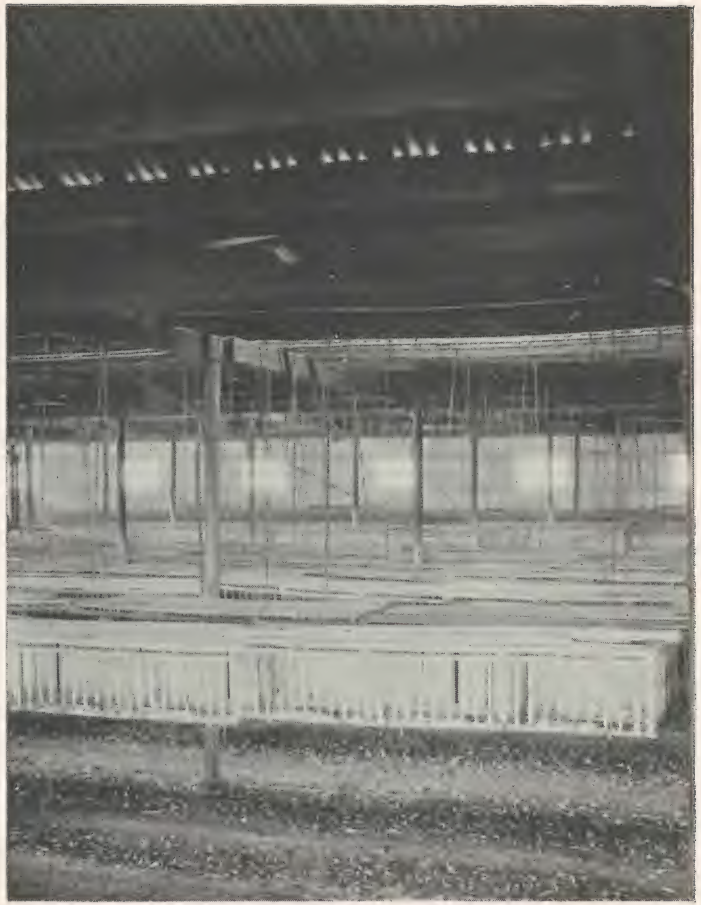
As we have already indicated the process of fattening or ripening can only be carried up to a given point. The customary plan where outside cages are used is to retain the birds in them from a week to ten days, feeding twice a day from the trough. During that time, there will be a considerable increase in weight which may range from 8 ozs. upwards according to the size of the birds. Large numbers are killed at this point, when it is found that they are plumper and that the flesh is much softer than would otherwise have been the case. These half-fatted chickens are greatly improved in appearance, commanding much better prices than would the lean specimens. Further particulars are given below.

Sheds.*—If the trade is entirely for half-fatted birds, there is no need except during the colder periods of the year for sheds, though these are very useful under special circumstances. Where it is intended to bring the birds to a higher stage of perfection, such sheds are necessary. Some are roughly built with the one idea of cheapness, whilst others are more complete and, in many cases, permanent buildings are used. The last named are generally loftier and are also warmer during severe weather than is possible with wooden erections. One important point to be kept in view is that whilst cleanliness in outdoor cages is important it becomes so to a greater degree in the birds under cover. Therefore, the most rigid cleanliness should be maintained. Whatever the form or pen employed it is necessary to remove the droppings daily, to lime-wash the house out frequently, and to treat the pens in the same manner between each occupancy. An excellent plan when cages are in single tier is to have a sloping shelf below, sprinkling upon it fine earth and lime and scraping down daily. The use of powdered lime or disinfecting powder, or a solution of

*Plate XCII.



Pair of Sussex Fat Chickens
(The perfection of poultry flesh)



Interior of Fattening Sheds
(J. Ruddin, Liverpool)

permanganate of potash, is requisite to keep down bacteria and parasitic life. Whilst sheds need not be elaborate they should be protective from direct draught and at the same time supply an abundance of oxygen. In many of the larger fattening sheds it is customary to have wide doors at either end, and during mild weather these may be kept open during the day. One excellent system which has been adopted in a large fattening shed near Liverpool, England, is to suspend the cages by wire strands to the roof, so that there was nothing upon which they needed to rest and cleanliness could be more effectively maintained.

Cramming.—The methods of fatting adopted are four in all: (1) from the trough; (2) by hand; (3) by funnel; and (4) by machine.

1. This method has been already referred to, and it is chiefly employed for the production of half-fatted specimens, which may either be kept in ordinary pens outside, or in a house and run, holding a dozen or a score of birds, which can be moved on to fresh ground as often as necessary. It is fitted with troughs at either side. One of these appliances, 6 feet long by 3 feet wide, is large enough for a dozen birds, and it is a suitable form for ordinary farmers. In Belgium the famous Coucou de Malines are fatted entirely from troughs, but they are kept in closely-covered sheds during the entire process.

2. Some of the finest fowls which are produced both in England and France are crammed by hand. The process is, however, slow, so that it is only suitable where labour is abundant and cheap. In a large establishment it would be impossible to get through the work if hand cramming were depended upon. The food is mixed to a thick paste, and formed into pellets or boluses about ¾ inch in length and ½ inch thick. There are two ways in which feeding takes place. In the one a sufficient number of the boluses are prepared, and the operator takes hold of the bird's head, either in the pen or out of it—in the latter case firmly gripping it between his body and left arm—opens the mouth with the thumb of his left hand, dips the bolus into a vessel of whey or milk, inserts it into the mouth, presses it down the throat with his finger, and then carries the food into the crop by running his finger and thumb down the outside of the gullet. The second plan varies somewhat. The operator sits upon a stool, with a lot of the paste and a bowl of whey or milk before him. The bird is placed upon his knees, its legs held firmly by them, the left hand holding the wings, and he

inserts a small quantity of the food, after dipping it in the milk, into its mouth, allowing it to swallow in the usual manner, there being no actual cramming. Both these methods are very simple. In some instances, a combination of the two methods is adopted.

3. Cramming by funnel is largely carried out in Southern Normandy. In this case the food is made into liquid form, about the consistency of ordinary cream. A specially-made funnel, the nozzle of which is carefully turned to prevent injury to the bird's throat, is inserted into the gullet until the orifice enters the crop, which can be felt by the finger, and the food is spooned therein until the crop is full, when the funnel is withdrawn. In operation the process requires a much shorter time than it takes to describe, but care must be taken, or there is great danger of choking the fowl. These funnels can be purchased at a reasonable price, and splendid quality of flesh is produced in this manner.

4. Cramming by machine is found to be the most expeditious, and the first cost is speedily saved in the labour bill. An expert operator can feed 250 birds in an hour, so that the duration of insertion is very short. Many people have the idea that this system is a cruel one, but it is not so. A careless or inexpert operator can hurt the subject, but it does not pay him to do so, as any injury to the throat or mouth would cause inflammatory action to be set up, and it would die. The tube which passes down the throat is made of indiarubber, and, as the cartilaginous rings of the neck are flexible, it enters quite easily. The way in which the fowls anticipate the feeding-time, after the first day or two, shows how they regard the operation. Various machines are sold in all of which the quantity of food can be regulated to a nicety. The chief thing is to cease pressure the moment sufficient food has entered the crop. A most important point in connection with the fattening of poultry is to give the food regularly, and if there is any remaining in the crop from the previous meal, not to feed at all. Several French cramming machines are made for liquid food, and attached to them is a long piece of indiarubber tubing, fitted with a spring tap or nozzle, so that the birds can be fed in pens without taking them out, the liquid flowing when the spring is released. In this case the nozzle is only placed into the mouth, not passed down the throat. The head must be held well up and the neck stretched to allow easy swallowing.

Food for Fattening.—Upon the nature and quantity of food supplied to the fowls during the process will depend the results attained. From the fact that all the time the birds are caged and can take no exercise, they are unable to effectively digest hard grain and anything of a fibrous nature. The reason why animals fatten better when such exercise is denied, is explained by Professor Warington, F.R.S. (1) who states that economy of food is promoted by diminishing the demand for heat and work. An animal at rest will increase in weight much more rapidly than one taking active exercise on the same diet. Temperature has also an influence. The increase from a given weight of food will be less in winter than in spring or autumn, from the fact that a much larger proportion of the food is consumed for the production of heat when the animal is living in a cold atmosphere. Hence the economy of feeding animals under cover in winter. If, however, the temperature becomes so high as to considerably increase the perspiration, waste of food again takes place, heat being consumed in the evaporation of water. A temperature most favourable for increase is apparently about 60° F. Quietness and freedom from excitement are essential to rapid fattening; the absence of strong light is, therefore, desirable.

As already indicated, hard grain should not be used for feeding birds undergoing this process. Food must always be soft, that is, composed of meal. In Sussex and the South Eastern Counties of England, the food almost entirely employed is ground oats, which is prepared chiefly by millers in the valley of the Medway. There does not seem any reason why this product should not be prepared elsewhere. In connection are, however, several considerations, first of which is the nature of the oats which are ground. From experience it has been found that English and Scotch oats are unsuitable for grinding, from the fact that they contain too much moisture and have thick husks so that they can not be ground fine enough for the purpose. Ground oats must not be confounded with oatmeal, as they have not been kiln dried but are fresh oats ground very fine, husks and all. The powder from oatmeal is often used for mixing though not so good. When obtainable, the plump, hard, thin-skinned Russian oats are found to be best for this purpose, and next to these are the best samples of Canadian oats. To prepare these the mill stones must

be cut very sharp and deep, and run very low. Consequently, the rate of production is somewhat slow. There is also a considerable risk of firing from friction unless great care is taken, and, consequently, the expense of milling is higher than is usual. Fatters, however, state that even though they have to pay more for high class ground oats, the results more than compensate. Cheaper mixtures are often sold, some of which consist partially of fine thirds. A mixture which is often employed consists of 1 part ground oats, 1 part fine Indian meal, and 1 part fine sharps. In Belgium finely ground buckwheat is almost universally fed and gives very good results. In France, buckwheat meal and fine barley meal are used in the same way. It is suggested that the greater content of lime in ground oats explains why, from this proportion, the finest flesh is produced.

Use of Milk.—To the meal should always be added soured skim-milk, butter-milk or whey from the curds. In Sussex the first-named is alone adopted, and one of the largest fatters sometimes pays as much as £20 (100 dollars) each week for milk during the busy season. Whole milk is much more expensive, and less satisfactory. The globules of butter-fat in it are too valuable, and can be substituted at a much cheaper rate. Surprise is often expressed that soured rather than sweet milk should be used. In practice it is found that the former gives better results. The acid generated by the turning of either milk, butter-milk or whey, causes more rapid digestion than would be the case if it were sweet. Not only is the milk itself soured, but when mixed with meal, as is the usual practice immediately after one time of feeding is over, it is allowed to stand for several hours, until a slight fermentation has taken place. There are distinct disadvantages from the giving of soured milk, one of which is that there is always a greater tendency on the part of the birds to scouring. Fatters who have tried both systems declare that soured skim-milk yields the better results, in that the birds will eat longer and digest their food more quickly than if sweet milk is employed, and at the same time there is less danger of what is known as crop-sickness. It is claimed that the acid generated in the milk has the tendency to prevent sickness, and also stimulates the appetite. A further advantage to the fatter is that he has not the same necessity to obtain his milk at the time when it is required, and, in fact, in many of the fattening establishments

great vats of milk are allowed to stand for weeks before using, bought up as obtainable. Milk contains a large amount of phosphates, which have the effect of whitening the flesh. Not only is this true in respect to chickens, but also ducklings, goslings, and turkeys. The use of milk at the time of feeding off the turkeys before killing is found to result in beautiful colour of flesh. Milk is one of the most valuable foods we have, and, in some parts of the country, the dairy districts especially, skimmed-milk is almost a waste product. Butter-milk does not appear to yield quite the same results. It contains a little more in the way of fat, and is somewhat richer. As already stated, it is employed in Belgium, and might be used wherever it is available. The late Mr. Lewis Wright (2) made a very interesting suggestion as to soured skim-milk. "The sour milk keeps the digestive organs in proper activity, without the use of fresh vegetables, which would otherwise be necessary. Tell a Sussex fatter to use 'boiled milk' and the green food which would then be required, and see what he would say."

In American fattening plants, except those where there is an abundant supply of skim or butter-milk, the product known as evaporated milk is generally used, and is a fairly good substitute. It may be noted, however, that in Europe white flesh is regarded as of the greatest importance. In America, yellow-fleshed birds are still popular, although there would appear to be a change in that respect due to milk feeding which bleaches the flesh and skin. We have seen some very fine specimens in Canada of high class milk fed chickens.

Feeding.—The question is often put forward that whenever fat forms on the body there must follow a certain wastage. When we increase the fat in the flesh, there are also deposits upon the organs of the body which are not edible. That, however, cannot be avoided. These globules of fat which are distributed throughout the muscles increase these in bulk, adding greatly to the weight of the bird, and at the same time improving both the colour and quality of the flesh which is softened as well as made more bulky. In all markets the value to a large extent is determined by this softness.

Frequently it is found that birds fret when first put up, by reason of the confinement, and, instead of putting on flesh, actually lose weight. To prevent this, they should be kept without any food for the

first twenty-four hours, or, if they have come a long journey, for the first twelve hours, by which time they are eager for food and forget about anything else. They then take a hearty meal and are content. Or a little broken maize may be spread on the top of the food in the trough in order to tempt them to eat. Coarse grit added to the mixture is of benefit. When trough-fed, all that remains must be taken away as soon as the birds are satisfied. Some fatters feed only once on Sundays, which is found to do no harm, though that is usually a question of labour.

Feathers and Manure.—It is often the case that what under ordinary conditions are more or less waste products, have an important place in the profits attained. That is true in connection with fattening establishments. The feathers and manure should be carefully collected and disposed of to the best advantage. Fatters who can arrange outlets are often able to pay their wages bill by the sale of these articles. Feathers should be sorted in accordance with the part of the body from whence they are obtained. If in sufficient quantity, feather merchants are ready to buy at almost any time. Manure must be dry and kept under cover. Whilst it is valuable for ordinary crops, it is specially useful to fertilise market gardens and should realise in dry condition, £2 10s. (12½ dollars) to £3 (15 dollars) per ton. Where the fattening establishment is run in connection with a fruit or ordinary farm, the manure can be applied either in wet or dry condition.

Killing Fowls.—Before dealing with the method of killing, a very important point should be mentioned, for upon that the palatability of poultry will largely depend. An interesting fact is that if a fowl is killed, plucked at once, and cooked whilst the body is still warm, the flesh is tender and fine in flavour. Should, however, what is known as *rigor mortis* be allowed to take place, that is, permit the body to become cold, what is stated above is largely lost. Under those circumstances, it is necessary to allow the bird to hang for several days during which there takes place a gradual softening of the flesh. This is understood by poulterers who hold the birds until these are in a fit condition for cooking. Frequently poultry keepers, whether for supplying their own tables or for sale, do not understand what is here stated, with the consequence that the birds, although these may be plump, appear to be inferior to those purchased in the shops.

A further point which, whilst known to those who operate upon a larger scale, is often disregarded by poultry keepers, arises from the fact that all classes of poultry should be kept without food for twenty-four hours before they are killed so as to empty the crop and the intestines. Much loss arises from neglect in this direction. Partly digested food rapidly decomposes after a bird is killed. If left, the skin over the crop assumes a green appearance, due to chemical action, and the same takes place internally. The value is considerably reduced, more especially in warm weather. Not alone is denial of food important for the reason stated, but that the bird will keep for a much longer period and is easier to draw. No cruelty is involved, as the body reserves would enable it to live for several days without any food whatever.

There are various methods of killing fowls. One is to hang birds up by the leg, and then thrust a pointed knife into the roof of the mouth, rather in a backward direction than to the top of the skull. This is so as to pierce the brain which is the centre of all feeling. If carried out properly, death ensues very speedily. The bird should be allowed to hang head downwards until the blood has ceased to run and be plucked immediately. This system requires firm handling without which there is grave risk of failing to accomplish the purpose and cause great pain.

Dislocation of the Neck.—This is the method generally adopted. In the hands of an expert operator it is most expedious, and with a minimum of pain to the victim. It is not easy to follow the method from a printed description. The bird should be held firmly by the legs in the left hand, which can grasp the ends of the wings also, the head in the right hand between two of the fingers back of the skull, so that the comb lies in the palm, the back of the bird upwards. The legs are then pressed against the left hip, and the head laid against the right thigh near the knee. Next, the neck of fowl should be rapidly and firmly extended or drawn to its full, and at the same time the head is suddenly bent backwards, by which means the neck is dislocated just below the junction with the head, and death immediately ensues, as all the large vessels are torn across. The operator must not be nervous, nor yet afraid, performing the work firmly and expeditiously. Muscular action will take place for a few minutes, but if the operation is effective no pain is suffered. It is always better to pluck

whilst the fowl is still warm, as the feathers then come out easily and the skin does not tear. There is no cruelty involved by so doing, for all sensation is at an end, the brain, which is the centre of all feeling, being completely severed from the body. In plucking, the operator should sit down, hold the legs in left hand, the head hanging between his knees, so that the blood flows towards the head and gathers in the neck. In plucking the feathers should be drawn with an upward pull—that is, opposite to the way in which they lie on the body. An expert operator can kill and pluck twelve birds per hour.

There is no doubt but that what is known as dry picking is the best method, although it needs expert handling, otherwise the skin may be torn. In America, for cheaper classes of poultry, what is known as the wet method is largely adopted. This may be economical in labour but it wastes entirely the feathers. As soon as the bird is killed it is thrown into a tank of iced or very cold water and allowed to remain until the body heat has been lost. The feathers then can be removed more rapidly, but the sudden chilling detracts from the appearance of the fowl, and is easily recognised by those who are accustomed to the trade. It is never adopted for first class poultry.

Shaping.*—The object of shaping is to bring the body into the form which will make it most presentable when offered for sale. It has the effect of throwing the meat up on the breast and, in some instances, making the fowl look much more plump. This is carried out in different ways. Over the greater part of Europe and also in America, the system is to place the fowls after they are plucked in troughs packing tightly side by side and weighting on top. The Sussex troughs are made V-shaped, the front of which is rather narrower than the back, and usually in three tiers. These consist of only twelve pieces of wood, namely, (first) two upright ends, 36 by 7 inches (second) three troughs each made of two pieces, at right angles, the back board 6 inches wide and the front 5 inches, and 30 inches long; and (third) three loose boards half inch shorter than the trough and 4 inches wide.

The *modus operandi* is as follows: As soon as the birds are plucked, which should be done carefully and thoroughly, the hocks are tied loosely together, so that the legs are flat against either side of the breast. Before doing so, however, some of the more skilful fatters draw the meat upwards by means of the hands, which undoubtedly

*Plates XCI and XCII.

improves the appearance of the bird, though it must be done carefully to prevent breaking of the skin. The operator strikes the stern against a wall, thus flattening and making it fit the shaping trough more easily. Each bird is laid in the trough breast downwards, with the neck and head hanging over the front. The first bird is pressed firmly against the end of the trough, and a weight or glazed brick laid by the side to keep it in position. When the second and succeeding birds are placed in the trough, the weight is moved along until quite full. It is necessary that they should be packed firmly and tightly. Next a loose board, 4 inches wide, and ½ inch shorter than the trough, is laid upon the back of the fowls, just behind the wings. Upon this are placed three or four heavy glazed bricks, or two weights (56 pounds for preference) and the fowls are allowed to remain in the trough for several hours—in fact, until they are quite cold and set. In some districts of England, and especially in Devonshire, birds are tied down, turning the wings underneath the body, and drawing tightly across the back with the legs and feet firmly tied at each side of the breast.

Another system, which is found almost exclusively in the Bresse district of France, is peculiar to that country, and to it is due the unique shape of Bresse fowls. Small poultry keepers and great fatteners alike adopt this method. Every fowl, no matter how small its price, is prepared in accordance with the following system. For this purpose two cloths are used, the first a piece of fine linen, and the second an oblong piece of coarse linen or canvas. The shape of the former does not so much matter, but the latter requires to be of a certain make, and is usually 17 inches long by 13 inches wide. So soon as the fowl is killed it is plucked, and whilst warm, wrapped first in the fine linen, and second in the coarser material; the latter is then drawn very tightly either by tapes or cords passed through holes provided for the purpose, or is sewn up with fine string. The cloths envelop it completely. It is stitched first from the stern up to the hocks, and then along the body to the neck, the legs being laid on either side of the breast and encased with the cloth. The fowls are dipped in cold water and allowed to remain in this position from 24 to 36 hours. When taken out they have a sugar-loaf shape, the head being at the apex and the stern at the base. The effect of this system is to smooth the skin and give it a very pleasing appearance.

Stubbing.—Whatever the system of shaping adopted, it is necessary that the bird be plucked carefully, and it is customary in some parts to employ the services of persons called "stubbers". If any of the feathers, and especially the short quills, are left in the flesh, they will, of course, materially depreciate the appearance. We desire to urge upon every producer the duty to himself and the industry at large of turning out the fowls in the very best manner possible. Some atters are very fond of breaking the breast-bone of fowls, and this is frequently done in Sussex. It is a most objectionable practice, and one that ought never to be adopted. As a rule, all Surrey and Sussex fowls are singed immediately they are plucked and stubbed; and when properly done this custom is most desirable, as it is simply clearing the skin of surplus hair and feathers. The flesh must not be blacked. Straw alone should be used.

Packing.—Much carelessness is shown in the packing of dead poultry, which needs especial care. We have seen crates of chickens opened, and their value materially reduced by reason of bad packing, many of the birds being "barked" or otherwise damaged. These ought to be packed firmly and evenly, and if this is done they will carry long distances in perfect safety. In England specially made crates, or "peds", as they are called, are employed, which combine lightness with strength. These are lined out with straw, with layers of the same material between each row. The birds are placed with the sterns to the sides, and in double rows. In France, linen cloths, which are first dipped in milk, are often employed, and for the better class of fowls they are to be recommended. It may be mentioned that some of the railway companies are willing to supply hampers free of charge for conveyance of dead poultry.

In order to obtain the best results, chickens should always be killed where they are fatted, otherwise much of the benefit obtained by the system will be lost. A fatted fowl will lose a considerable portion of its added weight if sent to market alive, due to the change of condition. The same thing is found in connection with larger stock. In these days of refrigerating chambers there is no difficulty in keeping dead poultry for several days, in order to avoid glutting the market.

Caponising.—This system has been known for centuries and, as in the case of larger animals, results in a great improvement of the

quality and considerable increase in the quantity of meat. The birds operated upon do not grow rapidly but, by destruction of the sexual influence, there is not the same hardening of flesh in the case of male birds as would otherwise take place. The best birds to be caponised are chickens which have never yet crowed and when about eight to twelve weeks is the right age. They must be kept without food for thirty-six hours or more before being operated upon. A good light (sunshine, if possible) should be chosen to operate in, and the full light should be allowed to shine into the chicken's side when opened. First, take two good thick pieces of string or thin cord 3 feet long; to one end of each attach a weight, or any equivalent in the form of a brick or stone, fastening the other end of the string to the chicken's legs. Then lay the bird on its left side, and drop the weighted end of the string over one side of the operating table. Now tie the free end of the second string round the bird's wings near the body, and drop the weighted end of this string over the other side of the table. The chicken will thus be properly secured, and the operator must stand so that its back will be towards him. The small feathers from hip-bone to ribs, over the last rib, must now be plucked off, and the ribs and feathers all round should be wetted with a sponge dipped in quite cold or ice water, if available. The wetting will serve to keep the feathers out of the operator's way, and will also numb the sensations of the fowl, so that it does not appear to feel the operator's knife. Stick the knife in ½ inch deep between the first and second ribs from the hip-bone, and cut downwards and forwards to the end of the ribs. Turn the knife, and cut nearly up to the backbone. Now put in the spreader, which is one of the instruments used, tempering the tension by a rubber band provided for the purpose to suit the size of the fowl, and with the spreader upon the ribs, after which split the inside striffin which covers the bowels. The upper testicle will now be exposed, and should be grasped by the grippers, which should be given one entire turn over so as to separate the testicle from its attachments, except the spermatic cord, and pull the testicle out. Treat the lower testicle in the same way. It is necessary to be careful not to rupture the large vein under the testicles, and also to remove the whole of the latter. The bird may be untied and allowed to go without the incision being sewn up, but for a few days it should not be allowed to roost. Birds

may in this manner be caponized in any number, and without loss of more than 1 to 2 per cent. Large breeds of poultry, when caponized young, well fed until ten or eleven months old, and then fattened, will weigh 10 to 15 pounds each, and the meat on them will be found of the tenderest and most succulent description.

It is to be noted that the chief dangers found in practice with all systems of caponizing is in tearing the veins near the testicles, which results in the birds bleeding to death, or in the losing of the testicles amongst the intestines, which latter is almost certain to cause inflammation and death. This seldom happens, except through want of care or experience, but it is important to have a good light in order to prevent it as far as possible.

Dressing and Trussing.—Whilst it is true that the dressing and trussing of fowls is poulterers' work, and that whenever fowls are sold through the trade it is better left in their hands, as they can thus meet immediate demands, a work like this would be incomplete without some description of the methods adopted. Where chickens are sold direct to consumers it may be essential that these be trussed. Cooks as a rule, however, are equal to the work, or ought to be, for the preparation of fowls by poulterers in some cases has obviated the need for a cook knowing more than how to boil or roast. It is somewhat difficult to describe operations like these, but the following is an attempt in that direction.

For Roasting.—Presuming that the chicken has been properly plucked (1) nick the skin of each leg through to the bone, just below the joint; (2) trim the pinions, cutting off the skin on outer side, so as to remove all marks of feather pits; (3) lay chicken on its breast, with stern towards operator, and head away from the body; (4) make a transverse cut in skin of neck about two inches from back, and lay skin thus loosened backwards, exposing vertebræ; (5) cut off neck and head about two inches in front of previous cut, thus leaving about two inches of neck skin; (6) turn bird round sideways, breast upwards, and laying back the neck to expose the front of breast; (7) press the thumb firmly down the Λ-shaped orifice thus exposed, loosen the skin, and insert finger into body to separate internal organs from breast-bone; (8) carefully cut out merry-thought; (9) turn bird round in the hand, make a transverse cut across the vent, immediately below the "parson's nose,"

and an angular cut at each side, which prevents the sides cracking when the bird is being drawn; (10) insert forefinger and find "trail", which cut off, loosen the intestines gently but firmly, and draw through vent, taking care not to break any organ; (11) now place chicken on the table breast upwards, and insert long needle between thighs behind leg joint, pressing to corresponding place on other side, using fine string and drawing through; (12) lay fowl over on table, and insert needle in first joint of wing, draw through and pass string over back, repeating on reverse side, here pull tight and tie up; (13) insert needle through body at end of back-bone, and also at end of breast-bone, but in neither case is it necessary to pierce the meat on breast; (14) carry string round legs and tie, the legs standing away from behind the body; (15) cut off toes; and (16) when the fowl is smoothed over by the hands it is complete.

For Boiling.—With the exception that it is unnecessary to cut the legs (1) proceed exactly as described for roasting to 10; (11) insert first and second fingers of one hand through vent, and loosen the skin on thigh up to hocks on both legs. This is an easy operation, only needing a little care to prevent tearing the skin; (12) make a cut through skin on inside of each leg about an inch above hock knuckle, and right to bone; (13) also cut to bone of foot immediately above top toe; (14) take chicken in hand, turn lower leg, or shank, under thigh, feel with finger inserted under skin for cut in leg, and draw leg under skin, repeating this process on other side. The feet only will now protrude, and they should be cut off; (15) insert needle through front of body and stitch wings as in roast (11 and 12) chicken, but the wings may be shortened and inserted under skin as are the legs; (16) pass needle through thighs behind, and tie up on back in front of stern.

Boneing Fowls is a much more difficult process, and takes longer to perform, but when skilfully done leaves the meat unbroken or torn. The bird is treated as for roasting 1 to 5, but is not drawn, the organs remaining in carcass; (6) after cutting the neck, take out crop and merry-thought; (7) begin to strip the flesh off downward from neck, glove-fashion, until wings are reached; (8) cut wing-bone through, just above second joint, and break it off; (9) turn bone backwards through the flesh, scrape it down as it proceeds, drawing it out completely, removing any splinters, repeating on other side; (10) resume stripping

the flesh from carcass, holding upwards, until legs are reached; (11) these must in turn be turned inwards; (12) cut bone at joint, and scrape with knife, until bones can be removed; (13) continue stripping until scallop is reached, when it must be cut, and the carcass comes out complete; (14) the breast fillets must now be removed carefully and entirely off the keel or breast-bone; (15) take fowl by legs and turn right way out, placing fillets within; (16) roll up, and it is ready for use in whatever form desired.

In all these operations cleanliness of the board, and constant wiping, as required, of the parts are most desirable.

Milk Chickens or Petits Poussins.—Milk chickens are very young birds, usually five to eight weeks old. They go under the same designation in Belgium, where they are most popular. In France they are called *petits poussins*. To a somewhat heavier class of bird in America is given the name of "Squab broiler". A very large trade is done in these milk birds in that country owing to the fact that with the extension of egg farming, there is a considerable number of cockerels of a small size for which a market is required. These, as soon as the sex can be discovered, are separated and specially fed for a couple of weeks to develop the quantity of flesh. So far as the great mass of consumers is concerned, this class of chickens is practically unknown, simply by reason of the fact that they are too expensive. The customary plan is to serve one to each guest, and at great houses the chef brings these round as the *pièce de resistance* of the feast. When plump and well cooked they form the most delicious dish that can be obtained among all the various grades of poultry, as the flesh is beautifully tender, and wonderfully abundant if the birds are killed at the proper stage.

Attempts have been made from time to time to introduce the raising of these milk chickens as a special business, but the business has not grown to any extent. Some years ago an effort was made to establish a so-called chicken farm in Belgium, where *poulets de lait* would be turned out by the thousand, reared upon shelves. That did not succeed. The mortality on the one side and the expenses on the other were too great to allow of profitable continuance.

Spring Chickens.—From April to early June there is a very large demand for what are known as spring chickens—that is, birds eleven

to fourteen weeks old. As a rule these have not been fattened in the manner described above, but simply fed a couple of weeks before killing on food in which soured skim-milk is used freely. It is entirely a question as to whether the birds have been kept growing all the time, and are killed at the right age. Immediately prior to the time when the birds cast their chicken plumage and the sexual instincts will be more fully developed, the body will be found heavier, and flesh more abundant and softer than will be the case afterwards, until several months have elapsed. That is the time they should be killed, and if of the right breeds will weigh from 2 to 3 pounds each. Such birds do not need fattening, except what has already been stated, and usually command good prices. They are profitable to the producer. They must, however, be marketed during the months mentioned, as the prices are lower later in the year.

Winter Fowls.—During the autumn and winter months there is a fair demand for larger birds weighing 7 to 12 pounds, for which good prices are paid, though the trade has not been developed in Britain to the same extent as in other countries. Such have always formed an important branch of poultry husbandry in France, notably in the Bresse country and in Normandy, where the splendid specimens marketed at Christmas and Mardi Gras (Shrove Tuesday) are among the finest we have ever seen. Although large in size—we have seen a couple of La Fleche weighing 23½ pounds dead—they are beautifully soft in flesh, which is very abundant. That is true of the Bresse, du Mans, and others. The secret is to keep the birds growing and to fatten off in the best manner. Most of the cockerels are caponized, but the perfection for flesh is the French *poularde*, that is, a pullet which has never laid an egg.

In some of the eastern United States, large quantities of what are called soft roosters are produced and with a considerable amount of success. The breeds used for this purpose are the Light Brahma (American type) and the White Plymouth Rock, both of which although slow growers, develop to a large size. There is no doubt that under specialised methods and where profitable markets are available, this is a branch which is capable of great extension. It is usually found that there is a considerable demand for large-sized fowls in winter, ranging up to 10 and 12 pounds.

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CHAPTER XXX

RACES OF DOMESTIC DUCKS.

CHAPTER XXX

RACES OF DOMESTIC DUCKS.

ROUEN.	KHAKI CAMPBELL.	CAYUGA.
DUCLAIR-ROUEN.	ORPINGTON.	RUSSIAN.
AYLESBURY.	MERCHTEM.	PENGUIN.
PEKIN.	BLUE TERMONDE.	MUSCOVY.
INDIAN RUNNER.	HUTTEGEM.	ORNAMENTAL.
BALI.	BLUE SWEDISH.	

The wide distribution of domestic ducks, due to the fact that this species in its wild state is one of the migratory birds, has been dealt with in Volume I. These birds have been tamed in almost every part of the habitable globe wherever man has passed from the primitive to more settled conditions. The breeds and varieties differ greatly in size, shape, and colour of plumage. With a very few exceptions those which are high in productive qualities, whether for eggs or flesh, are homely in appearance, more especially in coloration of plumage. Many of the ornamental ducks are characterised by remarkable brilliance, greater than in any other species of domestic poultry. As our aim is to deal with those races which, directly or indirectly, contribute to food supply of mankind, these latter cannot be considered at length.

It is of interest to note that Europe, Asia, and America have each their special tame members of this species. The greater number, however, if we include the ornamental breeds, are Asiatic in origin. In Eastern Asia duck breeding has been carried on for many centuries. The adaptability of the duck to change of environment, and the ease with which it can be domesticated, led to its being bred in captivity at a very early stage of the world's history.

We have already seen in connection with fowls that until the last half century, except where sport was the chief consideration, these birds were appraised in economic values by reason of their flesh

properties. Eggs were subsidiary, for the purpose of reproduction, limited to a short period of the year. Only the surplus were used as food during the Spring and Summer Months. Such was the case with ducks even to a greater extent, for the reason that duck eggs were not in favour for table purposes, as were hen's eggs, owing to their somewhat strong taste. With the advent of the lighter-bodied races of ducks, of which the Indian Runner is a leading example, small in body, very prolific as layers of eggs, which were milder in flavour and not so large, the weight has been thrown in that direction. To a considerable extent the heavier classes of ducks have been displaced by the smaller, in which eggs are of greater importance than flesh. The relative importance of breeds has, therefore, been changed, and within a very few years, not merely productively but in exhibitions.

ROUEN.*

Nomenclature : In all countries, Rouen ; except *Dutch*, Rouaan ; *Spanish*, Ruan.
Variety : One.
Classification : Exhibition, Table.
Colour of Flesh and Skin : Dark Yellow.
Colour of Legs and Feet : Orange or Orange-Brown.
Colour of Egg-shells: Pale Green.

Origin.—This breed is in direct descent from the Mallard, or wild duck, which it closely resembles in colour of plumage. Evidence would indicate that it was first domesticated in France. M. Cornevin says (1) : ' If it is only probable, but not demonstrable, that this race was created in Normandy, it is certain that in that region it is bred largely for sale in Paris and for exportation to England.' Our view is that coloured ducks have been bred in all parts of Europe, inclusive of the British Isles, but that the Rouen duck was formerly selected with especial care in Northern France, whence specimens were imported to Britain. Moubray says (2) : ' The only variety of the common duck among us is the Rhone duck imported from France, generally of a dark-coloured plumage, larger size, and supposed to improve our breed. They are of darker flesh, and more savoury than the English duck, but somewhat coarse. Rhone ducks have been so constantly imported for a great number of years that they are generally mixed with our native breed.' In the edition of Moubray, revised by L. A.

*Plate XCIII.

PLATE XCIII

ROUEN DUCKS

Meall, published in 1854, it is stated that 'the Rouen variety is known by several names,—as Rhone, from that department of France; Rohan, after the Cardinal of that name; and Roan, a word signifying (according to Bailey) a bay, black, or sorrel colour, intermixed with grey, the derivation he gives being the French word *rouen*, which not inaptly describes the shades of brown and grey plumage in which ducks of this variety are almost uniformly clothed; and will not this last at once explain the origin of the name Rouen, by which it is more correctly, or at least more generally designated? Although, from the fact of our receiving the principal supplies of this stock from France, many writers have supposed that application is taken from the town of Rouen.' The suggestion here made is not convincing. Dixon fails to do justice to the subject, and says (3): 'I am even uncharitable enough to suspect that incorrect names are purposely given to unusual varieties by a few poultry-merchants, in order to conceal the source from which they were originally derived. My notion is that the title Rouen and its aliases is only a trade name, intended to elevate the common sort into a choice and more marketable variety' which is undoubtedly correct in several other directions. Wingfield and Johnson (4) show that a brown duck was general in the fifties of last century, probably owing to the importations already referred to. Mr. Harrison Weir refers (5) to importations, suggesting that the reason why Rouen ducks were so common last century in the South of England, was that they were brought over from France 'to the coast farms, either by fishermen, or, what is more probable, by some of the numerous bands of smugglers that used to land and run their cargoes on many of the available places on the Sussex coast.' It may, therefore, be assumed that the Rouen is of French origin, though, as generally acknowledged, it has been brought to its highest perfection by British breeders. The former name 'roan' duck could be transformed into Rouen with some justification.

History.—It would appear that the term Rouen has been applied for nearly a hundred years. Dickson says (6): 'The tame variety most in request is the dark-coloured Rouen, or Rhone, duck, originally from France.' Its value was soon realised as greater than that of the common brown duck, more especially in the size of body, weight of meat, and brilliancy of plumage. That it has attained its greatest

perfection in Britain is universally recognised, in which respect the value of poultry exhibitions can be acknowledged. These led to the adoption of defined characters, and gave a great stimulus to improvement of the race. The best specimens we have seen in France and other Continental countries were either imported from Britain or the descendants of imported stock. Within recent years the Rouen has declined in popularity, both for exhibition and production, due to its slowness of growth, and the competition of other races of less complex coloration and which have met more completely market requirements. As a show duck it is *facile princeps* among the larger races.

Economic Qualities.—In flesh qualities the Rouen is the finest of all the domestic races, due to the fact that the meat is so abundant. It is also higher in flavour, and decidedly finer in quality than any other breed. The perfection of duck flesh is found on a well-grown Rouen duckling of five to six months, that is, from September onwards. The most profitable demand, however, is for ducklings in the spring and early summer, for which trade it is practically useless. Hence it is not kept by those who are compelled to take into account cost and returns. Autumn ducks are much more expensive to produce than are spring ducklings, due to the longer time they must be fed. When we take into account that such a bird, weighing 8 pounds will realise much less upon the market than a spring duckling of half the size and age, no further explanation is necessary why Rouens are so little kept. They are naturally hardy, thriving well where there is plenty of water and wood, are very tame, and attain a large size when fully grown, frequently reaching 11 pounds in the male and 10 pounds in the female The ducks are excellent layers of large-sized eggs, and if kept under natural conditions the eggs are usually very fertile. The youngsters can be easily reared, but are usually not ready to be fatted until sixteen weeks or more, and do not then lay on flesh nearly so well as eight to ten weeks later, when they can be fatted up to 8 pounds and over, sometimes weighing up to 11 pounds as stated.

Description.—The Rouen is a big, massive bird, very long and wide in frame, deep from back to keel, and full in front, showing a broad, deep breast; the back is long and broad; wings large and powerful, carried well up, the ends resting on the stern; the neck is long and graceful, with a curve yet not arched; head massive and broad, with

a long, wide, and flat beak, bright green-yellow, which is built in a direct line with the eye, with a black bean at the tip; eye bold and full; tail short, with stiff feathers, two or three of which are curled in the male; legs and feet medium in length, very stout in bone, set midway under the body; the feet are well webbed, and the toes very straight; the colour in legs and feet is orange or orange-brown, in some cases red; the plumage in the male is very brilliant during the breeding season, afterwards changing more nearly to that of the female, as in the Mallard or wild-duck; head and neck are a rich green, below which is a broad white band about an inch above the shoulders; breast deep claret, forming a clear plate; flanks, stern and abdomen are a blue French grey, the flanks and sides clearly marked with black, as are the small coverts of the wings; back and rump are a rich green-black, and the tail slaty-black; the flight feathers of the wings are slaty-black with a brown tinge, and across the wings are broad purple bands, outside which are narrow bands of black, and then an outer bar of white. The female has a ground colour of golden chestnut or brown, each feather pencilled with rich black, like chain armour; the wing-bar is the same as in the male, and the head and neck a dark chestnut-brown, the head showing a wide dark line from beak to neck. The general appearance in both sexes is that of a large, massive, strong duck, deep in body and very long. Weight: adult males, 9 to 10 lbs.; adult females, 8 to 9 lbs.

DUCLAIR-ROUEN.

Nomenclature: Duclair, or Duclair-Rouen.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: Creamy-white.
Colour of Legs and Feet: Reddish-brown.
Colour of Egg-shells: White to pale green.

Origin.—No evidence is forthcoming as to how this breed was produced. It originated in the lower regions of the Seine river in France. Brown ducks were common at one period all over Western Europe. It has probably some affinity with the Rouen.

History.—Attention was first called to the Duclair in 1879 (7), from which it was evident that the duck was exceedingly prolific and good in flesh qualities. Miss May Arnold afterwards stated (8) that

it is 'the remains of an old Norman duck, preserved by special circumstances from being crossed with the wild-duck into that duck which we have magnified into the English Rouen.' The Duclair is not much known outside its own district, although found in some other parts of France. It has not been taken up for exhibition in any country.

Economic Qualities.—This duck is very quick in growth, in which respect it equals the Aylesbury. Ducklings are ready for killing by the time they are nine weeks old. The flesh is abundant and of good colour. They fatten well, are very hardy, thriving in cold weather, necessary as they are reared under somewhat rough conditions. The ducks are excellent layers.

Description.—These birds are similar to the Rouen in that they are boat-shaped, and also as to the body colour, except that there is not the same brilliancy of plumage. It has, however, a white neck and breast, giving it a distinctive character. The beak of the drake is dark-green, and of the duck nearly black. The legs and feet in both sexes are reddish-brown. Weight: Males, 8 to 9 lbs.; females, 7 to 8 lbs.

AYLESBURY.*

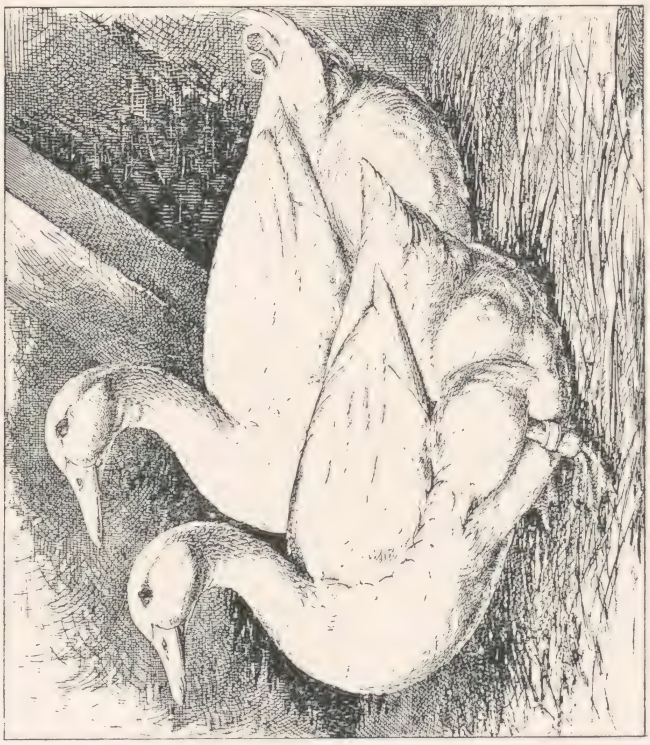
Nomenclature: In all countries, Aylesbury.
Variety: One.
Classification: Exhibition, Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Bright Orange.
Colour of Egg-shells: White, or greenish-white.

Origin.—White ducks appear to have been known for centuries and in many countries. The fact that white-plumaged ducks are occasionally produced as sports from dark or rich hued races in our own day may be taken as indicating the origin of the Aylesbury. A comparatively recent instance was given in the (London) *Standard*, February 15, 1899, by Mr. John Titterton, who wrote: 'Five years ago Mr. Charles Anderson, of Ely (Cambs), discovered two pure white ducklings in a brood of pure wild birds. These were caught and isolated, the result being that out of a team of wild ducks every bird is now hatched pure white. Nothing can exceed the elegance of these birds, either in their movement on the water or in their flight, which,

* Plate XCIV.

PLATE XCIV

PEKIN DUCKS



AYLESBURY DUCKS

by the way, seems to be rather more quick than that of their darker-coloured progenitors.' Mr. Harrison Weir, as quoted in "Our Poultry," made further inquiries as to these birds, which, after several years of selection, bred almost entirely white ducklings; and from the fact, also, that the eggs were white, he came to the conclusion that it was in this way the Aylesbury was produced. The changes which distinguish the last named breed, apart from coloration of plumage, from its wild ancestor are the result of breeding upon definite lines, and change of conditions and of food.

History.—This race was termed the White English by some of the older writers. In the early years of last century the name Aylesbury was given, due to the fact that duck-breeding was extensively practiced in the Vale of Aylesbury, Buckinghamshire, where the soil is specially suited to this industry, producing the finest specimens of table ducklings, the great majority of which were white. The first reference which we have been able to trace as to the name is in Moubray's Treatise (2), in the first edition of which, published in 1815, he says: 'The English duck, particularly the white variety, and when they chance to have very light-coloured flesh, are never of so high and savoury flavour as the dark colours. . . . The White Aylesbury are a beautiful and ornamental stock, matching well in colour with the Embden geese. They are said to be early breeders.' In Rees' 'Cyclopædia,' published in 1819, there is a paragraph dealing with ducks, chiefly in respect to management. Moubray's reference would indicate that the white ducks were at the time of his writing well-known under the term Aylesbury. Soon afterwards the name was generally adopted. In Britain this breed has proved to be one of the most valuable for early maturity and for its fine quality of flesh. It has also had a wide popularity for exhibition. The surprising fact, however, is that although many Aylesburys have been exported to other countries the breed has never attained the same position elsewhere, as it is thought to lack vigour of constitution under these newer conditions. Formerly it was suggested that there was some special virtue in the gravel or grit or soil of the Vale of Aylesbury and adjacent districts which explained its success. This has been disproved by equal success in other parts of the United Kingdom. The reason would appear to be that in the later decades of last century, owing to

extremes in breeding for exhibition and to too close mating, perhaps to over intensification, the birds showed marked signs of degeneracy and loss of constitutional vigour. The injury wrought, however, has been overcome, which may be attributed to an out-cross of the Pekin, and thus the virility of the Aylesbury was restored, without changes in its special characteristics. Further, extension of duck raising into other parts of the country, where it proved to be equally successful, gave the change of soil and environment so important in promotion of hardiness. At the same time the finest spring ducklings are produced in the County of Buckinghamshire and those parts of Bedford and Oxford which are adjacent.

Economic Qualities.—By reason of the quality of its flesh, rapid growth, and early maturity, the Aylesbury duck occupies the first position in British markets for this class of poultry. Ducklings can be produced in fine condition for killing within seven to nine weeks from the time of hatching, weighing 4 to 5½ lbs. In fact, to be sold as ducklings and thus command the best price they must be marketed by the time they are nine weeks old, for then they begin to cast their duckling plumage. As the season when prices for these dainty birds rule high in the English markets is from February to June, rapidity of growth is the most important factor in respect to the profit attained, as ducks are heavy feeders. The Aylesbury is light in bone, and carries a considerable amount of white or creamy-white flesh, which is well-placed on the breast. As layers these birds are excellent. When bred at the right season they commence to lay early, often in October and November. We have known flocks of Aylesbury ducks produce an average of 150 eggs in the course of twelve months. Trustworthy evidence is forthcoming of individual ducks laying between 80 and 90 eggs without a break. They seldom show any desire to sit, and are not reliable for that purpose. If one drake is kept with three ducks, or two drakes with seven ducks it will seldom be found that eggs are fertile, provided they have a fair amount of liberty and access to water. Kept under proper conditions they are very hardy. As mature stock they have not the size of body, or the flavour of flesh of the Rouen. For the duckling trade they have no rival.

Description.—In appearance the Aylesbury is boat-shaped, in that the line of body is level with the ground. Among exhibition stock

size has been carried to an extreme. The body should be deep, but not with the keel touching the ground as is frequently the case with abnormally-developed show specimens. Such birds lack the quality of early maturity, are inactive, and unreliable as breeders. The body should be long, with the legs midway between the breast, which should be prominent, and the stern. In weight the drakes should be, adult drakes 9 to 10 lbs.; adult ducks, a pound lighter. If the frame or skeleton is large at the beginning of the breeding season, the birds will be none the worse if they scale a pound less. Mere weight is a minor consideration. What is more desirable is a strong, large frame. One of the leading characteristics of the Aylesbury is the delicate colour of the bill and legs, the former being pinky-white. It has been claimed that this delicate colour can alone be secured in the Vale of Aylesbury. Undoubtedly it cannot be obtained upon strong soils. Wherever gravel is abundant in the streams or ponds, there it is general. Nor is the colour of the bill merely a fancy point, as it indicates the colour and quality of the flesh. The neck is moderately thick, the head and bill fine, long, and perfectly straight, whilst the legs are of a light orange colour. For breeding stock it is important that the bone of the leg should be stout without being heavy. Light bone is desirable for rapid growth, but there must be sufficient bone to indicate vigour. The plumage is pure white, without any sign of yellow or cream, which betoken Pekin blood. Some exhibition Aylesburys are too white, that is, the plumage has a washed-out appearance. This is due to the fact that the birds are kept under unnatural conditions, protected from sunlight, or is a form of albinoism. A slight bluish tinge, scarcely perceptible, indicates a combination of colours and not the absence of pigment. The only difference between the male and the female, apart from size of body, is that the former has two or three curled feathers in the tail.

PEKIN.*

Nomenclature: In all countries, Pekin, or Peking.
Variety: One.
Classification: Dual Purpose.
Colour of Flesh and Skin: Yellow.
Colour of Legs and Feet: English, Bright Orange; American, Reddish-Orange.
Colour of Egg-shells: White.

*Plate XCIV.

Origin.—Fortunately there is no doubt that the Pekin duck is a native of China, for its first importation thence took place within the memory of those still living, apart from the records which are available. Duck breeding has been extensively followed in China for centuries. Many travellers have described the duck-boats floating down the rivers, and the large numbers of birds surrounding them. Little has been said as to the breeds. From the fact that the Chinese are known to be responsible for several of our races of fowls and ducks, it is apparent that breeding on selective lines has long been known, probably far prior to adoption of such practice in western countries. That would explain the great prepotency of these eastern Asiatic races. We have often wished for the opportunity of travelling in the Celestial Empire, now the Republic, in order to discover whether there are other breeds as yet unrevealed to European and American poultry-breeders. Mr. Harrison Weir stated (5) that he 'had made inquiries of travellers who have visited Langshan, and learned that there is a white breed of ducks there that are not only distinct from ours, but larger and more beautiful.' Beyond that we have no information as to whether the Pekin duck is distributed over the entire country, or is restricted to smaller areas, or, further, whether the Penguin duck had any share in its origin. Should the information given to Mr. Harrison Weir, as quoted above, be correct, and also that given below to the effect that the first specimens were purchased in the City of Pekin, it would indicate a fairly wide distribution, as the city named and the Langshan district, which is on the Yantse River are considerable distances apart.

History.—Whether the Pekin was first imported into Britain or the United States of America direct from China, or that, as has been claimed by American writers, it was received in their country and thence passed to Britain, is not a question of moment, except as a matter of history. So far as the importations into the United States are concerned the statements are clear. The late Mr. M. C. Weld, writing in the first number of the *Fanciers Gazette*, afterwards the *Live Stock Journal*, published April 11, 1874, gave the following account (9):

'Mr. Jas. E. Palmer, of Stonington, a seaboard town of Connecticut, returned last year from a journey to the East, having visited China,

and its capital. He saw at Pekin some large ducks, which he at first took for geese on account of their large size, the length of their necks, and their large heads. A large number were secured and placed on board the ship in which he returned. All died except one young drake and two ducks, which landed in New York, March 14, 1873, and were successfully taken to Palmer's farm, near Stonington. They were indeed alive but dwarfed by the voyage, and not larger than good-sized Aylesburys. They recovered rapidly, and . . . the ducks laid constantly until the end of July, the number of eggs averaging considerably more than one hundred each.'

The above does not quite agree with a letter written by Mr. Palmer, and which was published in *The Poultry World* of September, 1874, as quoted by Mr. John H. Robinson (11), as follows:

'While I was in China . . . I was at Major Ashley's looking at his different varieties of poultry and animals, when he asked me if I had seen his ducks. I told him I had not. He said, "You passed by them when you came into the yard." We went to look at them. They were with some Barnacle Geese, and were about as large as the geese. I told him I must have some of them to take home. He said I could have them, and that he had brought them from Pekin. He spoke about Mr. McGrath having some of the same. A few days after, Mr. McGrath sent me a letter, saying he would like to see me at his office the first time I came on shore. I went there and he took me to see his ducks. He had fifteen. They were raised from Major Ashley's stock. He wanted to know if I would take them to the States. He said if I would he would furnish feed for them. I took them, and there being as many as I had room for, I did not get any of the Major's. I lost six of them in the China Sea; the nine remaining I succeeded in bringing to New York. I left two drakes and three ducks aboard ship for a friend of Mr. McGrath's.' In a letter published in the same journal, July, 1874, it was stated that Mr. McGrath had purchased eggs in Pekin, from which he hatched a brood at Shanghai, and bred those he supplied to Mr. Palmer.

Following upon the appearance of the article by Mr. Mason C. Weld, which was accompanied by a Ludlow illustration, there appeared the following letter over the signature of Mr. Raymond Harvey, of Coomb End, near Cheltenham (9): 'In your impression of April 11,

1874, I notice some letters and also an article on the Pekin Duck. I therefore should like you to know that that breed of ducks has been in the country for nearly two years, having myself brought them direct from Pekin in July, 1872. I at once knew them to be the same sort of duck, by the plate representing them in your paper. Their size is not exaggerated, as I think mine large. I have now a dozen, young and old, all laying well.'

We have not been able to trace any further reference to the Harvey ducks. Had he been a breeder out for business doubtless the new duck would have been exploited by him. There is nothing improbable in the story. In those days records were not kept at all carefully. The potential value of new breeds was not realised by the great majority of people. At any rate one tale is as good as the other until either is disproved. Certainly the Palmer record is the more complete. American breeders may accept as a fact that those in England have always acknowledged the Pekin duck was brought prominently forward and popularised in the States, and that nearly all the earlier stocks were transported from America to Great Britain.

The Pekin very rapidly won favour. In Britain its vigour, prolificacy, and hardihood were special recommendations. There is no doubt that, owing to inbreeding and intensity of conditions under which it had been kept for so long, the Aylesbury was showing signs of exhaustion, and there was not much opportunity for obtaining fresh blood at that time. In spite of the differences between the Aylesbury and Pekin, the latter was introduced into the former as an outcross, and contributed much to the restoration of the former as the premier duck in Britain for table properties. The results in respect to shape of body of this crossing in process of time passed away. The influence, however, remained in the renewed vigour. In America the Pekin won the first position and, as pointed out by Mr. John H. Robinson (11), it has been the foundation of Commercial duck growing in that country, where the Aylesbury has never found favour, probably from the fact that at a time when this branch of the Poultry Industry was developing, this race was lacking in the vigour of constitution which under the more strenuous conditions there prevailing is absolutely necessary. In such respects it is all important that a breed must fit its environment. The hardy nature of the Pekin enabled it to withstand the extremes of

climate. The great duck ranches in New England and Long Island have been almost exclusively created by the development of the Pekin. What has been the case in America is equally true in several European countries, more especially Southern Germany, Austria, and Hungary, where the Pekin has been regarded with especial favour, as it is found to be the hardiest of the white plumaged races of ducks. In Britain the Pekin has never attained the position of the Aylesbury. Its chief value has been as an egg-producer, and for crossing as already explained. Since the advent of the Indian Runner and other light-bodied ducks it has declined in popularity. Some of the earlier pioneers of duck ranches in America, notably the late Mr. James Rankin, of South Easton, Mass., whose place I visited in 1906, assumed that the Pekin duck had an objection to swimming in water, and was practically a land fowl. It is true that ducklings may be raised without water. The experience later has been that breeding stock thrive better when they have access to what is their natural element.

Economic Qualities.—As already indicated the Pekin stands at the head of larger races of ducks as a layer. It is remarkably hardy, bearing heat and cold extremely well, and is an excellent forager. In respect to size it appears to be larger than is really the case, owing to the abundance of its plumage. English experience has been that the pure Pekin is not so rapid in growth as the Aylesbury, taking two weeks longer to reach killing condition than the latter breed and not proving so abundant and soft in flesh. As a rule the more prolific birds lose in flesh qualities. Pekins are not found to fatten so well as the Aylesbury, and the flesh is of a deeper colour. But for the fact that eggs from larger breeds of duck are usually too strong in flavour for table purposes this breed would have attained wider popularity, by reason of its great prolificacy.

Description.—The earlier drawings of Pekin ducks represented birds which nearly resembled the Aylesbury. These would appear to have influenced breeding in both Europe and America. The ideals adopted by English breeders with regard to the native breed standards for the Pekin were made very distinctive, and inherent differences were developed, notably in carriage of body and colour tinge of the plumage. That there were such variations in the birds imported from China is evident from the description by Mr. Mason C. Weld in 1874 (9) who wrote:

'In colour these ducks are identical with common yellow-billed white ducks, but in form, carriage and plumage they are quite different. The legs seem further back, or else seem shorter, so that it appears difficult for them to walk with their bodies horizontal, as the Aylesburys do, but they go with rather an upward inclination, so as to throw the centre of gravity further back, rather penguin-like. Their frames are very large, certainly larger than the largest Aylesburys. Rouens we have here (i.e., in America) which occasionally weigh sixteen to eighteen pounds per pair. The plumage has a peculiar cast under the feather, and a notable peculiarity in both sexes is a great mass of fluff and feathers beneath the rump, which is not exaggerated in the sketch I sent you. Their heads are large relatively, and the necks rather long.'

In America breeding of the Pekin has been more nearly related to that of the Aylesbury in Britain, so that the differences have been greatly modified, specially in shape and carriage of body and colour of plumage. In 1906 the Author called attention to this fact (12) namely:

'There is not so much difference between the two (Pekin and Aylesbury) as is generally supposed. The English Aylesbury thirty years ago was re-invigorated and strengthened by Pekin influence, and it is apparent that there has been a considerable infusion of Aylesbury into the America Pekin. In shape the birds are nearly alike. The American variety has not the upright carriage and canary-tinged plumage seen in the English Pekin. The main difference is that our Aylesbury is bred for a flesh-coloured bill and creamy skin, whereas Americans seek for yellow in both of these directions.'

As a consequence there are considerable differences in the English and American Standards, which are indicated below. In body the Pekin is of medium length (Am. long), very broad, with a wide breast, which is carried well forward, and a full paunch. There is no sign of keel. The carriage is upright, as the breast is much higher from the ground than the tail, giving a suggestion of penguin shape, as in the birds described by Mr. Weld above (Am. slightly elevated in front, sloping slightly towards rear); neck thick and moderately long, well arched; head very large and broad (Am. long, finely formed) and the skull prominent, rising sharply from the beak, which is short, broad

and thick, and slightly curved. It is in colour bright orange (Am. orange-yellow); eyes dark-leaden blue; wings short and carried closely; tail full and carried high; legs of medium length, straight, stout in bone, and bright orange in colour (Am. reddish-orange). In colour of plumage the English Standard calls for buff-canary or deep cream, whereas the American asks for white, or creamy-white. The birds are active and alert, moving freely. Weight: males, 8 to 9 lbs.; females, 7 to 8 lbs.

INDIAN RUNNER.*

Nomenclature: *English*, Indian Runner; *French*, Coureur; *German*, Indische Laufenten 1; *Dutch*, Indische Loopeend; *Danish*, Indische Löeander; *Italian*, Corritrici Indiane; *Spanish*, Corredor Indio; *Hungarian*, Indiai futo.
Varieties: Fawn and White, Fawn, White, Pencilled.
Classification: Exhibition, Egg-Production.
Colour of Flesh and Skin: Orange, or rich cream.
Colour of Legs and Feet: Orange to tan.
Colour of Egg-shells: White.

Origin.—Whilst in the books published about the mid-years of last century references are to be found to birds of the penguin type, which have a similar carriage to that now known as the Indian Runner, the first actual reference to the last named we have traced was in 1876 in which Mr. H. S. Clarke wrote (13): 'Many duck fanciers down here (Cumberland) breed large quantities of them (the Indian Runners) and they all agree on one point, viz., that they are better egg-producers than any other breed they have ever had, but like myself are unable to tell what colour they should be; they are chiefly grey and white mottled birds, but in some yards I find them of a pale dun colour.'

This was followed by a letter (Dec. 29, 1876) from Mr. Thomas Armstrong who stated (13): 'I have known them for about eight years in Cumberland. On seeing them first I set them down as a cross betwixt Aylesbury and Rouen, but their upright carriage, small size and laying qualities, has done away with that idea; their laying season, if not old, is all the year, except when moulting or very dry and frosty weather. They like a wide range on grass, where few snails escape them. Their colour is grey and white, which should be evenly marked, no dark stray feathers among the white. I have noticed some with a brown cast and marked a little like the Shield duck and drake, which looks very pretty but are seldom met with. As for their origination

*Plate XCVI.

I can give no account, but before their appearance it was a rare occurrence to see a basket of duck eggs in the market in winter or very early spring.'

A small pamphlet was issued about 1885 (14) in which it is stated that about 1850 'A drake and trio of ducks were originally brought from India by a sea-captain to Whitehaven, and presented to some friends who at that time followed the occupation of farming in West Cumberland. . . . Another consignment was imported by the same gentleman some years later, and from these two importations it is probable that the present day Runner ducks are either directly or indirectly descended. They were not known to their introducer by any special or distinctive name, having simply attracted his attention when ashore by their active habits and peculiar penguin carriage.' In 1898 the late Henry Digby imported a trio of Runners from a friend in India, which did much to improve the birds then being bred.

Our attention was first called to these birds in the late 'eighties of last century, when they were found to be widely distributed in Cumberland and Dumfriesshire among the farmers, who kept them by reason of their prolificacy. The runner type was there though not so pronounced as it became later.

All the evidence which is obtainable indicates that the Indian Runner ducks originated in South Eastern Asia, inclusive of Malaya and the Island of Java, which latter is in one of the Dutch East Indian colonies. Dr. W. van den Akker, President of the Provincial Poultry Club of Java records that it exists in two colours, namely, white and what he calls roe-coloured. Considerable attention is given to the breeding of these birds, and there are a number of prominent breeders who have done much to maintain the purity of race. These birds are found to be excellent layers, though not so prolific as in western countries, which may be a matter of conditions or of selection. Another piece of evidence is supplied by Dr. B. J. C. Te Hennepe, of Rotterdam, who says (15):

'On the island of Java (Netherland East India) in the swampy area on the south shore, called Randja Ekkeh, these ducks are bred in thousands. When they are eight to ten weeks old they are put into flocks of about 1,000. Then a man goes walking with this flock along the roads in the direction of Batavia. Every day they walk a

small distance, the ducks foraging on the rice fields. The trip takes about six months. During this period the ducks start laying; therefore, the man bears on his back a kind of rope fencing. At night he puts the flock in this fence and sleeps himself in the same place. In the morning he first collects the eggs, and then they continue their way. In the villages he passes, he sells the eggs and also the birds which are too weak to run further; so that at the end of the run he only brings into Batavia market the strongest ducks, the best long-distance layers, and the best layers.'

Additional to the above may be quoted from the writings of a Dutch naturalist published in 1851, who stated (16): 'There is an unusual, a very wonderful variety of ducks. They are lean, with very few feathers, run nearly upright, and have a very long neck; they are principally reared on account of the eggs which are immediately salted, and for an article of food much prized by the inhabitants. They are cheap, many are sold to the sailors of the ships and prahus, who store them for their voyages.' That these were distributed to the adjacent countries, inclusive of China, is apparent.

The ducks, to which the name Indian Runner was given, and which were common in Cumberland and Dumfriesshire, had undoubtedly, in absence of fresh blood, been crossed with the Mallard, or wild duck, prior to the 'eighties of last century. When taken up by fanciers at that time further crosses were made. Nothing was then known of the ducks in Malaya and Java. Further, there was adopted a process of breeding which resulted in the elongated, abnormal, bottle-shaped exhibition Runner as now seen, in many respects a monstrosity. The fact, however, remains that these birds retained the laying quality to a remarkable degree. Hence their popularity, especially as the eggs were smaller and less strong in flavour than those from larger ducks, and were acceptable for table purposes.

In 1909 Mr. Walton, a well-known duck breeder, secured birds from the Far East of the original type. For business reasons he and others refused to state whence these had been obtained, which is deeply to be regretted. In 1924 the Misses Davidson & Chisholm, of Croy Gollanfield, Scotland, imported others. Again, however, the information as to the place of origin was kept a secret. Particulars of these birds are given below. The claim made that these are the true

Indian Runners may be justified. That name had, however, been given to the race evolved in Britain, and could not be changed, erroneous though it might be.

The late Louis Vander Snickt, when the Indian Runner became popular in Britain, suggested that English breeders had obtained it from the Netherlands, where birds of this type have been known for a long time. He acknowledged to the Author on several occasions with whom it was discussed, that, although he held the opinion strongly, there was no evidence in support. As a fact the existence of ducks with an elongated carriage in the Low Countries was unknown until much later. In the tenth edition of Moubray's Treatise (2) published in 1854, it is stated that 'Upon the coast part of the county of Norfolk, in the cottagers' yards are frequently to be seen specimens of a small Dutch breed, of a very pretty and peculiar appearance; the plumage is of a whole colour, either a slaty-blue or dun shade, or else a sandy-yellow or cinnamon, something like the fur of a tortoise-shell cat; a gentleman of our acquaintance, who had some of this latter colour, called them Rotterdam Ducks, having obtained them from that place.' Had these birds possessed the Runner type it may be assumed the peculiarity would have attracted attention. The Norfolk and Cumberland ducks had no relationship.

Unfortunately the legend, it is nothing more, of British breeders surreptitiously obtaining stock from the Netherlands, and bringing out the Indian Runner as descended from the Far East, has been promulgated in America (11) without justification. The only conclusions which can be arrived at are to the effect that these small-bodied, elongated ducks were imported both to Britain and the Low Countries independently from South Eastern Asia, where these countries have important colonies and constant trade connections. The trade routes from the east are equally open to English and Dutch ships, of which probably there are twenty English to one Dutch. Fiction at times enters into Poultry literature as well as elsewhere.

A very valuable contribution to the elucidation of what has been needlessly wrapped in mystery has recently been made by Dr. J. A. Coutts (23), confirming what has been stated above. In this it is shown that ducks of the Indian Runner type have been known in Java and Malaya for centuries, probably 2,000 years, and that these

are met with on some of the islands of the Archipelago. The information given is to the effect that recent importations to Britain of Runner ducks were obtained from Lombok, and that these either pure or crossed are widely distributed, in Eastern Asia.

Economic Qualities.—Ducks of this race are wonderful layers, maintaining a high flock average under ordinary conditions, and continuing in profit for several years. As already indicated the eggs are of medium size and are mild in flavour. The flesh is abundant for the size of body, fine in quality and well flavoured. Usually they are non-sitters. They are splendid foragers, and find the greater portion of their food when on range, so that they are inexpensive to maintain. Except where forced for high fecundity, inbred, and mated when immature, they are very hardy. Inclusion in Laying Trials has tended to weaken the stock.

Description.—In the extreme English exhibition type the shape is much exaggerated, and most of all in the carriage. These notes represent the more useful Runners. Body long and narrow, well elevated in front, and without any sign of keel, but with a well-rounded breast; neck long and fine, carried erect; the head is fine, rather flat, with a broad, strong, nearly straight bill, which is wedge-shaped; eye set high in the head; wings are well carried up, and the tail is curled in the male; legs of medium length, well set back; the general appearance is slight and racy-looking. So far as the later importations are concerned, the Misses Davidson and Chisholm state in a letter to the Author that the carriage is at a more forward angle than the modern show Runners. In head and neck they are about perfect and in this respect, breed perfectly true even when crossed with the Walton blood. These birds proved to be wonderful layers even in northern Scotland, commencing production within a fortnight of arrival after their long journey by sea and land.

Varieties.—The different colours of Exhibition Runners are given under the heading of this section. So far as the importations referred to above are concerned, one drake was a tall, slim bird, with long snaky neck, and a perfect wedge-shaped head, very rich dark claret colouring, fading into french-grey, that is of the usual fawn drake markings of the darker kind. Another was silver, heavier and not so upright as that just named. A third was very red in colour. These variations are due to the diversity usually found in naturally bred birds.

KHAKI CAMPBELL.*

Nomenclature : Khaki Campbell.
Variety : One.
Classification : Exhibition, Egg-Production.
Colour of Flesh and Skin : Cream.
Colour of Legs and Feet : Dark Orange.
Colour of Egg-shells : White.

Origin.—With fowls there have for many years been constant efforts to develop new races or varieties, in some instances with remarkable success. Of the four most popular breeds of fowls two are composite, and one (the light Sussex) owes much to an out-cross. In ducks until comparatively recent times breeds have been more or less stationary. With the advancing popularity of the Indian Runner, and the creation of a demand for duck eggs, a change was brought about, the end of which is not yet seen. The Khaki Campbell duck was the pioneer in these directions. Late in the last Century Mr. A. Campbell, of Uley, near Dursley, Gloucestershire, brought out a small duck descended from the Runner, to which the name Campbell was given. Other crosses were introduced, namely, with the Rouen and the Mallard, from which birds were produced with sandy-coloured plumage. From the fact that this tinge was similar to the garb of British soldiers in respect to colour the word Khaki was added to Campbell. Hence the name. We have no records as to the proportions of blood of the various foundation races.

History.—In this respect there is not much to be stated. With the growing popularity of the Indian Runner as an egg producer, followed by the exaggerations introduced in that breed for exhibition, an opportunity presented itself which was seized by those who had become interested in the Khaki Campbell. A Specialist Club was formed for the breed. Both in classes at exhibitions and by the remarkable records in Laying Trials it has made great advance. One fact has been evident, namely, that in attempts to improve what are desirable for exhibition these have not been permitted to injure the productivity. The risks in that direction were considerable as the Khaki colour is uncertain.

Economic Qualities.—Small-medium in size of body these birds, though good in flesh properties, cannot compare in that respect with the larger races. It is as layers that the breed has won its growing

*Plate XCV.

KHAKI CAMPBELL DUCKS
Ideal of the Khaki Campbell Duck Club:
Hon. Sec. Mr. Oscar C. Brown, Appleby, Lincolnshire, England.

popularity both on commercial plants and in Laying Trials. At the latter these birds have taken a very high place, in several instances giving the highest averages of all poultry competing. One duck of the breed produced two hundred and one eggs in two hundred and one days. Questions as to the effect of high production are discussed below.

Description.—The following indicates the ideals of the promoters of this breed: The general outline is that the head is carried high, with shoulders higher than the saddle; back gently slanting from shoulders to saddle; neck of medium length, almost erect, and graceful; chest well rounded and prominent, with a round underline; the body is compact, retaining depth throughout, especially from shoulders to chest and from centre of back to thighs; legs well back yet permitting good abdominal capacity without excessive sagginess in ducks; body moderately erect; carriage alert; plumage tight and sleek; wings carried close and high; tail short and small, with the usual curl in male; neck slender, medium length, almost erect; head refined in appearance, bill medium in length, depth and width, in a straight line with top of skull; eyes full and bold; high in skull; face smooth and full. In colour the drake has head, neck, stern, and wing-bar of bronze; brown shade preferred to green-bronze; rest of body even shade of warm khaki; legs and feet orange, bill green, the darker the better; duck khaki colour all over, as even as possible; back and wings laced with lighter shade of khaki, allowing lighter feathers in wing-bar; bill greenish black; legs and feet as near body colour as possible; head plain khaki; a streak from eyes considered a fault. Yellow bill, and white bib considered serious defects.

ORPINGTON.

Nomenclature: Orpington.
Varieties: Blue, Buff.
Classification: Dual Purpose.
Colour of Flesh and Skin: Creamy.
Colour of Legs and Feet: Orange-yellow.
Colour of Egg-shells: White.

Origin.—This class of duck was introduced by the late William Cook, originator of the Orpington fowl. With exception of the statement that the Aylesbury, the Rouen and the Cayuga were intercrossed with the Indian Runner, there is practically no information available respecting it.

History.—By reason of the recent introduction of the Orpington Duck there is little to be said. Up to the present it has not proved popular among exhibition breeders. Those who keep it are chiefly concerned with egg-production. It has made very good records in Laying Trials both individually and in flock averages. In a few instances these have been remarkable.

Economic Qualities.—Whilst an excellent layer this duck is more acceptable as a table bird than the Indian Runner and Khaki Campbell, in that it is larger and more fleshy, and the eggs produced by it are heavier. Ducklings grow quickly and can be marketed when ten to twelve weeks, at which age they will weigh 5 lbs. or over. They fatten quickly.

Description.—In shape and carriage this duck is of the type commonly known as boat-shaped, that is, the line of body is level with the ground. In that respect the Runner influence is not very apparent. It is lighter than the Aylesbury and Rouen, but much larger than the Indian Runner. The body is long, deep and broad; breast round and full; wings, which are strong, are carried closely; the tail, which is small, rises slightly; neck fairly long and curved; head fine and oval, with bill of moderate length, straight from the skull; legs strong, medium in length, well set apart; the carriage is slightly upright. Weight: drake, 7 lbs.; duck, 6 lbs.

Varieties.—There are two colours, namely, the blue, which is dark in shade on the head, neck and body, with a little white on the breast, indicating Blue Swedish influence. The buff has a rich shade of fawn on body, rather darker on head and neck.

MERCHTEM.

Nomenclature: Merchtem.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Creamy.
Colour of Egg-shells: White.

Origin.—The general opinion is that this bird is a sport from the Blue Termonde, but smaller in size of body. In shape and appearance it greatly resembles the Aylesbury, except that it is not so large, and the bill has frequently a blue bean; also the legs are blue. These give it a distinctive character.

History.—Prior to the Great War of 1914-18 this duck was extensively bred in the Merchtem district of Belgium, to the north-east of Brussels, where were to be found a considerable number of duck breeders. It was bred entirely for practical purposes, in order to supply the Brussels markets during the early summer. The light soil met with in and around Merchtem was most suitable for these birds. Personal observations show that they have been bred around Merchtem for a very long period of time.

Economic Qualities.—This duck is famous for its flesh qualities, as it makes rapid growth, and produces an abundance of meat, which is very white and most delicious in flavour, with a mellowness that satisfies epicures. The ducks are prolific layers of large-sized, almost white-shelled eggs. It is usually bred under somewhat unnatural conditions, and, therefore, is not among the hardiest of the species, the method adopted not including the provision of water to swim in for young or old stock. In some of the establishments we have visited, the ducklings are reared in enclosed yards, similar to those used in Buckinghamshire. The birds grow and fatten rapidly.

Description.—In body this breed resembles the Aylesbury except that it is smaller. It is long and boat-shaped, the line of breast being level with the ground ; the neck is of medium length, and well arched ; the head is fine and the beak straight and long, reddish-white in colour ; the legs, which are somewhat longer than on the Aylesbury, are set in the centre of the body, and are yellow in colour ; the plumage is white, with a tendency to blue, and might be termed bluish-white. Weight : males, 6 to 7½ lbs. ; females 5 to 6½ lbs.

BLUE TERMONDE.

Nomenclature : *Belgian*, Bleu de Termonde ; *English*, Blue Termonde ; *German*, Blaue Termonde ; *Dutch*, Blauw Termonde ; *Danish*, Blaa Termonde ; *Spanish*, Termonde Azulado.
Variety : One.
Classification : Table.
Colour of Flesh and Skin : White.
Colour of Legs and Feet : Red-Brown and black.
Colour of Egg-shells : Bluish-white.

Origin.—In Belgium the opinion is held that the White Merchtem is a sport from the Termonde duck, which latter is bred in the valley of the Scheldt between Ghent and Malines. There is no evidence available as to its evolution. Ducks with blue plumage have been

widely distributed in Western Europe. Dixon mentions (3) that ducks were to be met with in Norfolk having a slate-blue or bluish-dun plumage; and Mr. Lewis Wright says (17): 'The late Mr. Teebay several times told us that, about 1860, there was a recognised local race of large blue ducks in Lancashire.'

History.—The Blue Termonde duck has had wide distribution in mid-Belgium, one reason for which is that the peasants of that country believe birds with this colour of plumage are less easily seen by their enemies, both human and animal, than if they are white or red. Also that blue plumage in ducks is usually associated with vigour of constitution and quality of flesh. The race has been taken up for exhibition to a limited extent.

Economic Qualities.—This duck is large in size, and produces a considerable amount of flesh. Like the Rouen it is slower in growth than some other breeds. The flesh is excellent in quality, and good in flavour. It is reared in a hardy manner and is very vigorous in constitution. On this point M. Vander Snickt stated (18): 'Exercise developes the muscles of the part of the body set in motion. A duckling developes by exercise along the muscles of the thighs; those of the breast come by heredity, because it is fatted and eaten before it has had the need to use the wings.'

The great value of the Blue Termonde is in crossing with softer-fleshed races. When so mated with ducks having white or creamy flesh and skin the colour of these is not adversely affected, whilst the quality and proportion of meat are greatly improved. This is a bird of great vigour, hardy in the extreme, and the ducks are excellent layers. It is probable that the Termonde and Huttegem ducks are allied or have a common ancestry.

Description.—The Blue Termonde is very long in body, broad, and deep, carrying the breast well in front, and retaining the boat shape; neck fairly long, well arched; head, which is carried well back, is large, broad, and long; beak is also long, and blue in colour; legs, of medium length, and feet are red-brown and black; plumage is what is usually termed blue, that is, slate-grey evenly throughout the body, each feather slightly bordered with black. In some specimens the throat is white. That, however, is not general. Weight: males, 9 to 10 lbs.; females, 8 to 9 lbs.

Above: Breeding Pen of White Indian Runner Ducks
(Bred by Dr. J. A. Coutts, Southport, England)

Below: Huttegem Ducks
(Bred by Author)

HUTTEGEM.*

Nomenclature : Huttegem.
Varieties : Blue, Dark Fawn or Tawny.
Classification : Table.
Colour of Flesh and Skin : White.
Colour of Legs and Feet : Blue, or slate.
Colour of Egg-shells : White or pale green.

Origin.—In the absence of definite information it is generally assumed that this race is the result of crossing the Blue Termonde, or a progenitor of that breed, upon a smaller duck with a long and narrow body of the Runner type. When that took place it is impossible to say, probably in the earlier years of last century. Belgian duck breeders did not pay much attention to colour of plumage until the rise of exhibitions, so long as the type of body and colour of bill and legs were in accordance with their views.

History.—This duck has been bred extensively for many years in the Audenarde district of West Flanders, where hundreds of thousands of ducklings were raised annually. The name is derived from the village of Huttegem, near Audenarde, as that is the centre of the industry. The district named is low lying, with large areas of water meadows. In the streams grow abundantly water lentils, which are regarded as necessary for ducklings. The requirements are a hardy, rapid-growing duck, attaining maturity early, and commencing to lay when five to six months old. It does not appear to have been bred elsewhere.

Economic Qualities.—The Huttegem duck is an early layer, usually commencing production in August and September. The eggs for hatching are almost entirely from young stock. The ducklings are very hardy indeed, which is essential as they are put out on the meadows when two days old, even if the ground is covered with snow. They are given access to water from the outset, if the ice has to be broken in the streams and water courses. Only the most vigorous birds could stand such treatment. With these birds the deaths are few. They are splendid foragers, roaming widely in search of worms and other natural food inclusive of wild lentils. The ducklings grow rapidly. At five to six weeks old they can be put up for fattening, so that they are ready for killing at eight to nine weeks after

*Plate XCVI.

hatching. The flesh is fairly abundant, and fine in flavour. The ducks are prolific layers, and do not sit.

Description.—Of a medium size, the Huttegem is long in body, rather narrow, flattish in back and round below, deep midway between the legs, and rather higher in the breast than the stern, without being upright; neck short; head long, with a small forehead and straight, flat bill; the back of the head in the male, neck, breast, under-parts, and wing-flights are white, the head and rest of the body coloured as stated below; on the head around the eye above and below is a U-shaped marking, coloured as the body, with white inner semi-circle; the beak is blue, a white line dividing it from the head; legs and feet slate-blue.

Varieties.—In the Blue the head and body are slate-blue, and in the Tawny a dark fawn.

BLUE SWEDISH.

Nomenclature: *English*, Blue Swedish; *German*, Schwedische; *Dutch*, Zweedsche Blauwe; *Danish*, Blaa Svenske; *Spanish*, Suees Azulada; *Hungarian*, Svèd Kèk.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: Creamy-white.
Colour of Legs and Feet: Orange-red.
Colour of Egg-shells: Pale blue.

Origin.—This duck has held a recognised position in Germany for many years, where it is bred to a considerable extent. The statements made are to the effect that it was introduced about 1835 in Pommern, which at that period was part of Sweden. Hence the name given to the breed. It is probable that the Blue Termonde was derived from the same source, and that both have the same progenitors. It is more than likely that these birds came from farther East, and it is suggestive that the countries in which blue ducks are met with extend along the shores of the Baltic Sea.

History.—Very little information is available as to these birds, which we have seen in several northern European countries. As already mentioned blue ducks were at one time known in the North of England. Specimens were imported into America in 1884 and onwards, and have attained a fair measure of popularity. It is thought they were obtained direct from Germany. In Britain they have never found favour either for exhibition or production.

Economic Qualities.—Although these ducks are good average layers, e gg-production is their secondary quality. They are specially noted for flesh properties. The meat is abundant and well distributed, and is fine in flavour, due to the fact that they are bred under natural conditions. It has been stated that when kept under domestication, unless there is careful selection of the stock, they lose much of the blue colour of plumage. The Blue Swedish is not a rapid grower, but fattens well and makes large, plump, meaty birds.

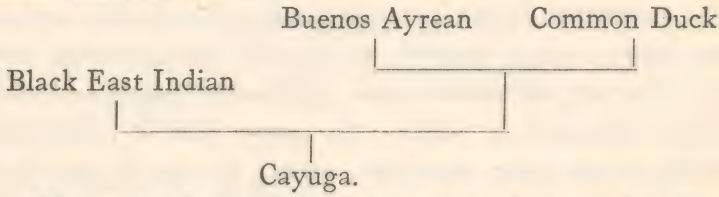
Description.—The body is long, broad and deep, with a full, round breast, well balanced upon the legs, following the Rouen in shape and carriage; back level, long and broad, with a slight concave sweep from shoulder to tail; neck strong, slightly arched, of medium length; head round and broad, with a flat forehead; beak in a straight line from the top of the head, rather long, broad, in the drake olive-green, in the duck much browner; eyes round, full, and dark brown in colour; wings large, carried closely; tail broad, well extended behind; legs and feet strong, rather above the medium in length, and with toes well spread, orange-red in colour; the upper part of breast and front of neck up to the lower mandible, white; the rest of the plumage dark steel blue-grey, the outer edges of the feathers marked with black, except the outer flight feathers, which are white. Weight: males, 6½ to 8 lbs.; females, 5½ to 7 lbs. The general appearance is that of a strong, massive duck, rather above the medium in size, yet not so large as the Rouen.

CAYUGA.

Nomenclature: In all countries, Cayuga.
Variety: One.
Classification Exhibition.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Dull orange-brown.
Colour of Egg-shells: Very dark green.

Origin.—The evolution of this handsome race of duck, which has never received in Europe its full mead of attention, is uncertain. That it was introduced in America appears to be undoubted. In the early part of last century, however, a large black duck was common in the North of England, probably a sport from the Rouen. The accounts as to the origin of the Cayuga are very indefinite. Miner

states (19) that it 'is undoubtedly a cross between some wild variety and the domestic duck,' and Stoddard says (20) that 'it is said to have originated on the shores of Cayuga Lake, and to be a cross of the wild black duck upon the common Mallard.' That it was probably first made known in Cayuga County, New York State, may be accepted. We suggest that it is a native of South America, although some specimens may have been captured in the northern half of that Continent. Large specimens of what are now called Black East Indians were known in the mid-years of last century, called Buenos Ayrean. The appearance of the two are so similar, except in respect to size, as to justify the above opinion. In Europe the Black East Indian has been bred on small lines. In process of time it would be easy to make them distinctive. Possibly South American ducks found in North America were crossed as follows:



History.—Miner, already quoted, writing in 1878, says that 'this variety of duck has been bred by Mr. J. S. Clarke, of Cayuga County, New York for nearly twenty years, and . . . though Mr. Clarke has bred them for that length of time, they were first brought to notice through the columns of the *Albany Cultivator* in 1851. Mr. Havard, the editor (now of the Boston *Cultivator*) having seen in the market some ducks of this variety, dressed, and weighing about 8 pounds each, and always having an eye to the useful, traced them to Mr. Clarke, since which time the stock has been more widely disseminated.' It would appear that the first Cayuga ducks were imported into Britain from America in 1871. These have had a limited number of admirers, less, however, than formerly, yet have never found acceptance for practical purposes, more especially as the birds are full in flavour of flesh. To secure richness of plumage Black East Indian blood has been introduced, which has had the effect of decreasing the size of body.

Economic Qualities.—The Cayuga is a fair layer, very meaty, carrying a considerable amount of flesh on the breast, which is richer

in flavour than is usual with the softer-fleshed races. The meat is pale, though not so white as that on the Aylesbury. They are very hardy, the chickens rear easily, except where in-breeding has been resorted to for exhibition. The crossing of a Cayuga drake upon Pekin ducks produces quick-growing ducklings, excellent in quality of flesh.

Description.—The body is very long, wide, and thick from back to keel; sternum blade is large, well covered with muscle; breast carried forward, and the line of body level with the ground; neck long, tapering to the head, well arched; head large and broad, the bill long and flat, the latter in a line with the eye; wings large, carried close; tail full and long with the usual curled feathers in the male; legs rather long, raising the body well above the ground, and strong in bone, in colour of a dull orange-brown, lighter between the toes; plumage a deep metallic black, with a greater brilliancy on the wings; eye black; bill of a slaty-black, showing a jet black saddle down the centre distinct from the sides, and stopping at the bean, which is deep black. Weight: English Standard, males 6 to 7 lbs.; females 5 to 6 lbs.; American Standard, males 7 to 8 lbs.; females, 6 to 7 lbs.

MUSCOVY, OR MUSK.

Nomenclature: *English*, Muscovy, or Musk; *French*, Barbarie, or Musk; *German*, Moschus; *Dutch*, Muscaat; *Danish*, Moskus; *Spanish*, Muscovy.
Varieties: Pied Black and White, White, Black, Blue-dun.
Classification: Exhibition, Table.
Colour of Flesh and Skin: Dark cream.
Colour of Legs and Feet: Orange-yellow.
Colour of Egg-shells: White.

Origin.—This breed is a native of South America, where it is found in a wild state. To it the names of Pato, or Brazilian Duck, have also been given. It is, however, generally known under the designation as above, which has been the case for about a century. It is of special interest by reason of its peculiar features and that it came from the New World. For reasons stated below it has never been popular.

Willughby and later writers at one time regarded it as a distinct species. That, however, has been disproved in actual experience. Where sterility in crossing has taken place this may be due to changed conditions. It is stated to inhabit the hottest parts of tropical America. 'During the day it lives in swamps, where it finds congenial food, and towards the evening may be seen sitting in rows on the

lower branches of large trees, descending thence to make inroads into the maize plantations and cornfields, where it does considerable damage, plucking up at the same time the mandioca or tapioca plant.' (21) Specimens were received by the Zoological Society of London in 1851 and 1880 from South America. The Muscovy Duck differs from other races in that it is in direct and immediate descent from its wild progenitors. As to the method of domestication no evidence is forthcoming. That, however, is a simple process as we have already shown.

History.—The earliest reference we have come across referring to this breed is in a French work (22), and Caius mentioned it in 1670 under the name of the Turkish duck. Willughby, who died in 1672, speaks of it as 'a wild Brazilian duck of the bigness of a goose,' giving what is yet a correct description. Nearly all naturalists refer to it in a similar manner. Coming to the era of poultry breeding, it does not meet with much favour. Moubray says (2) that 'Muscovy and other foreign varieties of the duck are kept rather out of curiosity than for the table.' The reasons are stated below. In the revised edition of the last named book, published in 1854, an interesting account is given of the names accorded to it—Brazilian, Peruvian, Guinea, Musk, Muscovite, Muscovy, Turkish, Barbary, etc. This is too long to quote. Briefly stated it is to the effect that in the sixteenth century merchant adventurers who traded beyond the seas took high-sounding names for their companies, such as the 'Muscovite Company,' in the reign of Queen Elizabeth; and as geographical knowledge at that time was very indefinite, names were accorded to novel importations which were, to say the least, misleading. But we incline to the opinion that the term 'Musk duck,' by which it was at one time known, due to the peculiar odour emitted by the flesh of old birds, was corrupted into Muscovy. Specimens are always to be met with, and a number of breeders find it useful for practical as well as for ornamental purposes.

Economic Qualities.—The Muscovy duck is generally admitted to be a poor layer, though cases are recorded where the reverse has been the case. It is a large-bodied bird, quick in growth, and carrying an abundance of meat, which is darkish in colour. The flesh is fine in flavour. Dixon says (3) that 'the Musk duck is excellent eating if killed just before it is fully fledged; but it is longer in becoming fit

for the table than the common duck. Their flesh is at first high-flavoured and tender, but an old bird would be rank, and the toughest of tough meat. It is strange that a dish should be now out of fashion as scarcely ever to be seen or tasted which, under the name of Guinea duck, graced every feast 150 years ago, and added dignity to every table at which it was produced.' These ducks fly well but do not wander much. They are good graziers, can be kept easily in confinement, but are very savage, and their evil temper makes it practically impossible to keep other poultry with them, and explains why they have never become popular, in spite of their flesh qualities, among farmers. They are hardy and vigorous.

Description.—In body the Muscovy is very long, sometimes measuring two feet, broad and deep, and are boat-shaped ; neck and legs are of medium length, and fine in bone ; head large and broad, ornamented on top with a tuft of feathers, the bill is small and curved ; the face around the eye is entirely bare and bright red, but the chief peculiarity is that on the front of the head is a bright red knob of flesh not unlike a cherry, which with the featherless face gives it a raw appearance ; wings are large and strong, and the tail stands well out ; bill, legs and feet are orange-yellow. There is considerable difference in size of the male and female. Drakes 8 to 10 lbs. ; ducks 6 to 7 lbs.

Varieties.—The wild specimens are largely black, with a few white feathers on the head. Considerable variation has resulted from domestication. There are now Pied Black and White, Pure White, deep Black, and Blue-Dun. Of these the White are the more ornamental.

PENGUIN.

In the early decades of last century a race of ducks was imported from the Far East to which the above name was given, by reason of the fact that these were almost upright in carriage, due to the legs being set far back in the body. The legs are short, and they have a waddling gait, yet are active. The body is very long. These appear to be common in the Malayan Archipelago, and are known in India. It is probable that from this race is descended the Indian Runner, and that it exerted an influence upon the Pekin.

Mr. Harrison Weir states (5) that ' Mr. Cross, of the Surrey Zoological Gardens (1837-1838), had several which bred on the island in

the lake; these were of a light and dark fawn colour, the ordinary blue bars on the wing being of a dull slate tint. The ducklings were extremely odd-looking little things, and frequently fell in their attempt to walk fast or run. The next that came under my observation were at Birmingham, December, 1858, and were the property of Lord Berwick. These were of a rich hazel and fawn in colour. Some are extremely pretty, being of a dull blue, light brown, blue-black, and splashed freely with white, having markings much in the same way as the Indian Runner ducks, of which I believe them to be a closely analogous variety.'

RUSSIAN.

During the Author's visit to Russia, in which country and Siberia there are probably many races of ducks, as of fowls, unknown to us, the only breed of definite character seen was called Indian. We could not, however, obtain any reliable information as to their origin, history and economic qualities. The birds seen were of medium size and boat-shaped; drakes had a fawn-coloured body, with brown feathers in the tail, except that the neck and back of the head is white, the rest of the head brown; bill dark green, with a line of white dividing the bill from the head. In the ducks the plumage is fawn, spangled or splashed with white, the neck and back of head as in the drake; in both sexes the legs were red. Weight: males, 7 lbs.; females, 6 lbs.

Among Ornamental Ducks there is a very great variety. Many breeds are characterised by remarkable brilliance in colour of plumage, and fineness in markings. These are not within the scope of economical breeds of poultry.

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CHAPTER XXXI

THE DUCK INDUSTRY.

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THE DUCK INDUSTRY.

EGG-PRODUCTION AT LANDSMEER—DUCK EGG PLANTS—FEEDING—AYLESBURY DUCKLINGS — SELECTION AND BREEDING — EARLY HATCHING—METHODS OF DUCK FARMING—SUPPLY OF EGGS—HATCHING AND REARING—HOUSES AND SHEDS—FEEDING OF STOCK DUCKS—METHODS OF REARING—SYSTEMS IN BELGIUM—HUTTEGEM AND DISTRICT—AMERICAN DUCK FARMS—FEEDING IN AMERICA—FEEDING AND FATTENING OF DUCKS—KILLING AND PACKING.

Modern developments have greatly extended duck breeding, so that our discussion of this branch has to be regarded from two aspects. Ducks have always proved themselves to be good layers, even those races in which flesh properties were supreme. With a few exceptions no attempts were made to specialise in the direction of egg-production, for the reason that the demand for duck eggs was limited, mainly for cooking and cake making. As a rule the strong flavour of these eggs made them unacceptable for boiling, poaching or frying. In that respect a considerable change has taken place following upon the introduction and popularity of smaller-bodied races of ducks whose eggs are more palatable. It may be true that these are lacking in the delicate flavour of hens' eggs. They are, however, high in nutritive elements and feeding values. Hence there is an increasing opportunity for duck keeping on commercial lines, and specially for small operators.

On the other hand there has been a considerable reduction in demand for ducklings during the last few years in Europe, that is, as meat. These birds must be classed among luxuries by reason of their high prices and the small relative amount of flesh, which makes them expensive, beyond the purses of all save the wealthy. Limitation of

income following upon the Great War, and high taxation, have reduced the consumption. This may be temporary. It has, however, to be considered at the time of writing. Such is not the case in America where money is plentiful. Under such conditions can be found an explanation for the highly prosperous duck farms met with in Eastern Canada and the United States. To be profitable, as ducks and ducklings are heavy eaters, it is necessary that the time of rearing shall be shortened as much as possible. Ducklings are birds nine to twelve weeks old, in accordance with the breed, and killed prior to the time when the duckling feathers are cast and the adult plumage assumed. When the change indicated has taken place, although the cost of production has been considerably increased, the market value is less in spite of the fact that there is much more flesh. In fully grown winter ducks the meat is usually abundant, fuller in flavour and higher in nutrition than is the case with that of ducklings. These would not be profitable under commercial conditions owing to high costs of feeding if that had to be supplied.

Egg-Production at Landsmeer.*—The first systematic example of keeping ducks for the sake of their eggs known to us, was in the Landsmeer district of North Holland where, on the sides of water courses communicating with the canals, a large number of plants were met with, on which the great majority of owners made a comfortable living. The methods are highly intensive. The following quotations give details of breeding and management (1):

The Landsmeer duck industry is exceptional, not alone by reason of the methods adopted, but also that no birds are bred there, and that egg-production is the entire object. In the adjacent communes are great dairy-farms upon which the ducks are hatched and reared, the price paid for them being usually 2s. (50 cents) each at three or four months old. When bought they are selected for uniformity into flocks of fifty or sixty, and placed in what are to be their dwelling houses. The duration of life is three years. In size the ducks are small bodied, without any distinctive type, perhaps rather larger than Indian Runners, of which we did not see any trace, and their shape, whilst long and developed behind, is ordinary, that is, level from front to back. Some follow closely the Mallard, or wild-duck, in coloration of plumage and markings. A considerable proportion, however, show a white

*Plate XCVII.

VIEWS ON DUCK EGG FARM, LANDSMEER, HOLLAND

(*Above:* General View, with Waterway and Polder. *Below:* Range of Houses and Runs, the latter enclosing flowing water)

cravat, or crescentic marking, across the throat, in which case the general plumage is black, or very dark, Some specimens with Mallard marking, carried a very long bill which curved downwards, the upper and lower mandibles being alike in this respect. These were reported as most prolific layers.

The number of ducks in the individual occupations varied considerably, ranging from 100 to 4,000 birds. The range is usually between 600 and 2,000. In all, however, the methods adopted are remarkably uniform. The duck houses, built of wood and having open fronts, are placed parallel to the streams with enclosed yards in front, about 30 feet in length and 6 feet to 8 feet wide, divided by wire netting and wood. Of the length about 6 feet is water, so that the birds have constant access to what is their natural element. That undoubtedly has a great and beneficial influence upon them. The water sections are divided by boards about 2 or 3 inches apart, so that the water passes through freely, and is thus kept sweet and clean. By these arrangements the canals are left free for barges to pass. The yards are littered out with straw. As often as necessary a fresh supply is provided, the old being allowed to remain, so that it becomes in process of time a thick bed, and is removed about once in two years and proves to be a valuable manure. The houses are simple in the extreme and substantially built. The canals are really the highways of the Netherlands.

Maize is largely employed for feeding, supplied in open troughs. The most important article, however, of the duck's diet is a small white fish, called Nest, which term means small fish, caught in the Zuider Zee. Many of the boats which go out from the picturesque village of Volendam are engaged in catching this fish. Of late years there has been great increase in demand for the fish, not alone by the increase of duck keeping at Landsmeer, but elsewhere. It is regarded as indispensable for ducks. What will be the effect when the draining of a large part of the Zuider Zee is carried out remains to be seen. Results with other fish have not been equally satisfactory. When brought to Volendam the Nest is transferred to large tanks on barges, and carried to the duck farms, where it is placed in wooden tanks suspended in the water until required, when it is fed alive.

Duck Egg Plants.—Wherever there is a running stream or a lake which can be enclosed for ducks there is opportunity for establishment

of a duck farm, whether for flesh or eggs. Claims have been made that this element is not necessary, which may be true up to a certain point. It is no doubt correct to state that ducks will lay whether they have access to water or not. That they thrive better with it cannot be questioned. Here again may be stated that if the ducks are kept for laying, and not intended to be used as stock, the test is whether they retain their health and vigour and are profitable. Breeders should never be denied what is natural to them. Moreover, they find a large part of their food in stream or lake thus reducing the costs of production.

Houses for laying ducks should be simple. An excellent one is described by Mr. H. S. Godsmark (2) : 'A house 16 feet square, 7 feet high in front, 5 feet high at back, the front boarded up 2 feet 6 inches from the ground, the remaining 4 feet 6 inches being wire netting, with a weather board extending out 3 feet over the front to prevent rain driving in, will hold up to 80 ducks comfortably, and can be built very cheaply of corrugated iron, which if tarred looks quite well. I let the iron into the ground to keep out rats. A common felt, not tarred, should cover the roof, fastened to the rafters before fixing on the iron, as this prevents the moisture condensing on the roof inside. Engine ashes with a little sand on top, rammed hard, make an excellent floor, with wheat straw for bedding. Open-fronted houses are always best for ducks.' It is desirable to allow about four square of floor space for each inmate. These houses should either be in large runs, part of which is water, or where the birds can have free range.

Feeding.—The class of duck to be selected is indicated in the previous chapter. All the signs are that ducks respond very rapidly to selective breeding, and some of the records made are remarkable. There is, however, considerable danger if this is carried too far, either by unnatural conditions or stimulating feed. The development of ovarian troubles, the loss in size of body, and rapidly advancing in shell and post hatching mortality, as well as deaths of older birds, are danger signs which will not be ignored. Many notes of alarm have been uttered, and not without cause. Nature will not be coerced.

Much has yet to be learnt as to what feeding will help production and also conserve health. Miss A. E. Barr, writing for the Utility Duck Club (England), says (3) : 'The original food of the duck in its

wild state consisted mainly of insects, small fishes, grasses, etc., obtained from streams and wet ground. Therefore the domestic duck should as far as possible be fed in a similar way.' The following are taken from notes by this lady issued by the Club named above.

'For laying ducks on good range, the safest rule appears to be to feed sparingly in the morning, and to give as much as the bird wants in the evening. If the ducks are on free range as on a farm, they should not be fed at all in the morning between March and October. In confined runs they appear to require a small morning feed, preferably oats. If cabbages or any greenstuffs are available these could be fed at midday, and mash given in the evening. Whatever way ducks are kept they should be given as much good nourishing food as they want last thing at night.

'As regards the mash, boiled vegetables or house scraps can be used to make bulk, but the addition of 8 to 10 per cent of a good fish meal appears essential. This should not contain more than 4 per cent of salt or oil, and the amount used should be calculated on the total weight of the food given. Vegetable and animal foods are absolutely necessary for laying ducks, and they are very fond of raw cabbages or greenstuffs of any kind. A concentrated mash is not desirable and good results have been obtained from a mash made up of roughly 60 per cent Middlings; 15 per cent broad bran; 15 per cent Maize meal; 10 per cent Fish meal. This mash needs to be varied according to the weather and the egg-production, etc. Boiled potatoes, when cheap, are also useful to save meal, but should only be used in small quantities except for fattening purposes.' Other suggestions are that in hot weather a small quantity of flowers of sulphur should occasionally be mixed with the food, and that there should always be a supply of water and shells within reach at feeding times. Food should be fed in deep troughs, and not thrown upon the ground. Those who take up duck keeping for egg-production will do well to study the results of experience and experimental work, be guarded in taking up new fads which often, though apparently successful, are ultimately harmful. Also, observe the recommendations made in Chapter XXVIII with respect to laying hens, and not depend upon high producers as breeding stock, certainly until these have reached their maturity and proved that they have been able to stand the strain which

is inseparable from heavy laying. Above all let it be remembered that the time of maximum production is not when reproductive qualities are greatest.

Aylesbury Ducklings.—The production of ducklings for killing has been successfully carried out for generations in European countries. So far as English experience is concerned at one time this branch was almost entirely restricted to Buckinghamshire, with Aylesbury as the centre. Within more recent times it has extended into Bedfordshire and Oxfordshire, so far as that section of mid-England is concerned. The pre-eminence which at one time was accorded to the three counties named has not been maintained, as other districts are equally productive. The claim that there was some special virtue in the Vale of Aylesbury, more especially in the gravel there general, has been disproved, although the conditions are favourable. The duckers of Bucks believed that they need fear no competition, and refused to advance with the times. It was not for many years after incubators had been successfully operated in other parts of the country, that they were prepared to add to their productive power by substitution of the artificial for the natural method of hatching. In that respect the younger men have recognised the necessity for progressive methods.

Selection and Breeding.—Of supreme importance is the selection of breeding stock, not only as regards the breed—though that is a necessary consideration—but as to the age of stock and time of hatching. The Aylesbury has no superior for early ducklings. It is a rapid grower and a ready fattener. A cross, however, between the Aylesbury and the Pekin, using a Pekin drake to Aylesbury ducks, is often found to possess a greater amount of vigour. The parents should be from well bred stock, be large in size, well grown, and early hatched.

Early Hatching.—In order to secure the highest returns it is necessary to supply the markets with early birds, that is, during the spring months when prices are high. Hence supply of hatching eggs has to be organised. Ducks or other poultry if allowed to breed when they commence to lay naturally, should the stock ducks be late hatched, and if fed carelessly, do not come into profit much before the month of March, which is altogether too late. Those who desire success to secure the most profitable trade must commence to hatch in the late autumn. That the business is profitable cannot be doubted. It has

been estimated that as much as £70,000 (350,000 dollars) has been annually received for these birds by duckers of the Aylesbury and Leighton Buzzard districts for ducklings. Ducks are very hardy, and will thrive almost anywhere, if they are given proper attention. More than any other class of poultry they adapt themselves to intensive conditions.

Methods of Duck Farming.—The process is rapid. The whole period from the time of egg-production to killing of the duckling can be comprised within three months. These birds can be raised thickly on the ground. It is by no means exceptional for 1,000 to 1,500 ducklings to be raised and fattened on an acre of land, and within a period of six to seven months. The chief danger to be guarded against under such conditions is contamination of the soil, and not allowing time for exhaustion of the ammonia before another season comes round. That explains failure in some cases. For reasons given below the land on which ducks are kept thickly during one season should not be used again for three or four years, and meanwhile be heavily cropped. There are limitations imposed by Nature which cannot be disregarded. Consequently duck-raisers should not occupy the whole of their land in any one year, and adopt a system of rotation. This is easy of accomplishment for the reason that houses and runs are simple and readily moved from one location to another.

Supply of Eggs.—Under such intensive conditions the keeping of an adequate number of stock would restrict the space available for rearing. For that reason in Britain small duckers, as they are called, buy eggs for hatching. Those who have more land at command organise the business from commencement to completion. That is also the case in the United States of America. Stock ducks must have liberty and access to water. For them liberty means water more than land. The system of buying eggs has much to recommend it provided that the quality of stock from which these are obtained can be maintained. There is a dual benefit, namely, that it makes for conservation of constitutional vigour, and that the duckers are thus able to secure eggs which are produced under more favourable conditions than would be possible if the stock had to be kept in small runs. Unless stock have sufficient exercise, they cannot be expected to lay eggs with strong embryos, which is of the utmost importance. The breeders

find the business profitable. For very early eggs as much as 12s. (nearly 3 dollars) per dozen is often paid in December. Contracts for the entire season range from 3s. (75 cents) to 4s. (1 dollar) per dozen.

Hatching and Rearing.—Hens are largely used for hatching, although incubators are chiefly relied upon in these days. The period of incubation is twenty-eight days. Ducklings require much less brooding than do chickens. The progeny of half a dozen hens when hatched can be given into charge of one hen, and proud she will be of her large flock. From the first the feeding must keep in view the development of flesh. Only those foods which are high in flesh and fat-forming elements should be selected. Kept in batches of about fifty, these are fed with regularity as much as they will eat. In each pen should be placed a trough of fine gravel which acts as grit. The birds consume considerable quantities. Many ducklings marketed have never known what it is to be able to swim, but are permitted to bathe in shallow tubs filled with water. Such as are intended for use as breeding stock should be allowed to range and given access to running water. The pens or runs in which the former are reared are small, for which is a reason. Fresh straw is supplied daily, and forms a valuable manure. The greatest trouble is with cramp, to which ducklings are very subject if the place is damp.

The skill of the feeder is exemplified by the rapidity with which he can have the ducklings ready for market. Every day of life means a serious addition to the cost, as they are heavy eaters. The earlier the birds are brought to the killing stage, the greater the certainty of securing the best prices, and vacating the runs for other batches. The majority of ducklings are killed when seven or eight weeks old, at which time they weigh four to five pounds. It is of the utmost importance to kill as soon as they are ripe, after which they begin to loose weight and there is danger of heavy mortality. It is no uncommon thing for a ton of ducklings to be dispatched from the chief centres in one day, representing about 7,000 birds. Ducklings are very nervous. The presence of strangers disturbs them, and they do not make any growth as a result.

Houses and Sheds.—So far as adult ducks are concerned these should be given as much range as possible. Under these circumstances the houses may be scattered about the land. Ducks sleep on

the ground and do not need a house as lofty as do hens. At the same time it should be at least five feet in height, so that there may be effective ventilation. As drakes are not usually quarrelsome the mated flocks need not be restricted in number so long as one drake is allowed for each four or five ducks. The house should give four square feet of floor space for each inmate, and be wire netted in front. Where the birds must be kept within a measure of confinement, their quarters should be in the neighbourhood of running water or a pond, and yards enclosing both water and land be arranged. The location of the house should ensure that it will be dry. Therefore, it must be above the level of the water at any season of the year, otherwise by percolation in the soil the floor will be damp. Around the house should be an enclosed yard, made of wire netting 2 feet wide or of hurdles. Ducks are very prone to lay away. They should be kept within the enclosure until 10 or 11 a.m. by which time, as a general rule, all will have laid who are doing so that day.

Feeding of Stock Ducks.—As explained in connection with fowls, food which is supplied should be supplemental to, and not take the place of that which can be obtained naturally. Everything, therefore, depends upon the last named. It is not only most conducive to health and vigour, but supplies many elements of which we know nothing. It is essential that ducks shall have sufficient food, otherwise they cannot be productive, and their eggs will not be provided with the requisite strength of contents. On the other hand, if fed too highly they are liable to become fat and cease laying. The staple foods are as stated above. Animal food in one form or another appears to be a necessity, such as butcher's scraps, though Fish Meal is a useful substitute. If fed judiciously, meat will give the needed stimulus to the egg organs in winter when the natural food is scarce, yielding the elements required for a constant output of eggs. The meals should be well mixed, adding as much boiling water as will make it into a crumbly mass. On no consideration must it be fed in sloppy condition. The use of troughs prevents wastage, and what is left can be removed. Unless non-supplied food is plentiful, which is usually the case in the spring, they should be fed twice per diem, that is, early in the morning, and about an hour before they retire for the evening. An excellent plan is to throw a handful or two of whole oats into the water in which the birds swim or bath during the day.

Methods of Rearing.—Ducks are poor sitters and mothers. As a consequence incubators are almost universal, and have proved most successful. When the ducklings are hatched, unless hens are employed to take charge of the flocks, the young birds should be kept under cover in a roomy shed for a week, divided into flocks of about fifty, divided by movable L-shaped boards 30 inches long by 12 to 15 inches wide, and 11 inches deep. No heat need be applied except that early in the season lamps may be hung from the roof and will deflect warmth. At the end of a week they may be transferred outside. In cooler weather rough sheds may be provided, placed in a good run. At a later period these are unnecessary. Around are runs formed by 2 feet wire netting. If properly fed the growth will be very rapid. In some cases long range houses are provided, divided into compartments, and with open yards in front. The disadvantage of these is that the ground cannot be changed and is liable to become contaminated. In America it is customary to use runs, and to keep the ducks in larger flocks than as stated above. It will be evident that the rearing of ducklings is a simple process. Care, however, must be taken not to expose them unduly to adverse influences. Such birds as are intended for use as breeding stock should be raised on range.

Systems in Belgium.—Well watered plains and valleys in Belgium offer excellent facilities for duck breeding. The great rivers, with their contributory streams, are extensively utilised in this manner. In the district dealt with below the industry is wide spread and highly specialised. Ducks are kept by a large number of farmers, few on each place but great in the aggregate. There is a general idea that ducks sweeten the land. Upon what that is based we do not know. Duck manure is very valuable and fosters the growth of the finer grasses. That is borne out by general experience elsewhere. Around Ghent large numbers of ducks are to be seen. In the Malines market, we have found a considerable number on sale. Throughout Flanders and Hainaut ducks are in evidence everywhere. The systems adopted have been the practice for centuries. Duck eggs are in large demand, as they are thought to have the flavour of those from wild birds. (4)

Huttegem and District.—One of the most important duck centres in Belgium is in the valley of the Escaut, near the city of Audenarde, in East Flanders, where the valley is flat and broad, flanked by hills

of a fair elevation. It consists of water meadows, which are flooded in the autumn, remaining under water until February, when they are drained. Upon these meadows, which are communal property, ducklings are raised in large numbers, finding an abundance of natural food, and in return greatly increase the fertility of the land by their manure. When flooded, the valley is a vast lake, nearly two miles in width. The roads and dwellings are just above the water line. During March and April a hundred thousand ducklings may be seen on the meadows. In April the birds are removed and the land left for hay. After that crop is cut the meadows are used for cattle and chickens.

As a general rule breeding ducks are accommodated in one of the ordinary farm buildings. The ducks wander over the meadows in search of food, but are not allowed out until they have laid. They return in the evening, when they are shut up. The Huttegem hen described in Chapter VI, Volume I, is used for hatching. In these the maternal instinct is so strong that the hens will sit for three months without a break, contentedly taking three nests in succession. When the ducklings are hatched they are kept warm for a couple of days, frequently near the fire place in the dwelling house, after which they are transferred to coops made of straw, placed in the farm yard for a few days, and then removed to the open. These coops are burnt after use, to destroy all parasites. Later the ducklings are permitted to wander over the meadows, where they find an abundance of natural food. Hatching commences in August, so as to have ducklings ready in January. Hence it is necessary to use young birds as layers. The system is essentially Spartan. When the water courses are frozen the ducklings are placed in the open and allowed access to water, even if ice has to be broken. Yet they thrive and make quick growth.

Natural food in the shape of worms and plants is abundant for the older ducklings. At earlier stages the feeding is liberal. For the first three or four days a mixture of hard-boiled eggs, chopped fine, buckwheat meal, and Indian meal are made into a paste, and fed upon sacks, together with worms, after which two or three feeds per day are given of steeped buckwheat, or of buckwheat meal mixed with maize meal, as supplemental to what is obtained on the meadows. On this diet they grow rapidly. They do not make the size as does the Ayles-

bury. When about six weeks old they are sold to the professional duck fatters at Lebbeke and Merchtem, who complete the work. Methods adopted in other parts of Belgium vary somewhat, but need not be described.

American Duck Farms.—Commercial production of ducklings has attained its highest development in the United States of America, where operations are distinct from those in Europe, in that the plants are usually on a large scale and not in the hands of small producers. A considerable number of these duck farms are to be found in the States of New York, especially on Long Island, Massachusetts, New Jersey and Pennsylvania. It has been estimated that from the section of Massachusetts around South Easton and Wrentham half a million ducklings are marketed annually, and that the production on Long Island is several times greater. The chief differences between European and American methods are—(1) That in the latter the buildings are substantial and permanent, in some cases very large, usually in long ranges. These are economical of labour, and probably in costs of equipment. There is, however, considerable risk of tainted soil, the effects of which have been acknowledged by several breeders, and explains decline in some districts. (2) As a general rule the breeding stock are kept upon these duck farms, which system has many advantages especially as selection of stock is under greater control, requiring, however, the need to avoid inbreeding, and loss of virility by denial of range and change of environment. (3) That what is known as the " dry " method is adopted, so that both adult and young stock are deprived of their natural element—water—in which to swim. And (4) That artificial methods of hatching and rearing are universal.

Feeding in America.—The method adopted by Mr. A. J. Hallock, of Long Island, for adult ducks, is as follows (5) : ' One bag of bran ; one bag of corn meal ; two pails of flour ; one pail of beef scrap ; two pails of grass ; and four pails of last year's clover. Just enough water is added to make it slightly moist, and it is mixed in a dough mixer.'

So far as the feeding of ducklings is concerned the system adopted by Weber Bros., on one of the most successful New England duck farms, is (6) : ' Feed five times a day until the ducks are three weeks : equal parts of corn meal, bran, low grade flour, ground Graham bread,

rolled oats, 5 per cent of meat scrap, a little oyster shell and fine grit, and a little finely cut green rye. After three weeks give: two parts corn meal; one part bran; one part middlings; 10 per cent of meat scrap; a little oyster shell and finely cut greenstuff. At six to seven weeks begin to feed the following fattening ration: Three parts corn meal; one part low grade flour; three-fourths part meat scrap; three per cent of oyster shell. When greenstuff is available add one part to the mixture.'

Feeding and Fattening in Bucks.—In the Aylesbury district feeding varies considerably in accordance with individual ideas, and also the food available. Many breeders use hard-boiled (infertile) eggs, mixed with boiled rice, though some give toast soaked in water. After three to seven days of this food, the birds are supplied with paddy (undressed) rice, carefully simmered, and toppings (the local name for fine sharps or middlings), or upon barley meal and toppings. Variety stimulates the appetite. This is continued until the ducklings are five weeks old, by which time they have attained a large size.

A different plan is at this stage adopted, for the frame thus built up must be covered with the flesh, and feeding should be to that end The ducklings are divided into flocks of about twenty to thirty, as near as may be alike in age and size. They are fed from long wooden or metal troughs, of which there should be a sufficient number to allow every duck to find a place. Quantity of food can only be gauged by the appetite of the birds, and the attendant will by observation find out how much is necessary without any waste. There must be no shortness. Water is not supplied until the ducks have eaten, and then in small quantities. It is not usual to allow access to water for swimming until a day or two before killing, when a bath will cleanse the plumage.

The food supplied during the final three weeks is of a fattening nature. What is known as tallow graves, or scrap-cake, is used to a large extent when it is obtainable. Whilst there should be a variety of food, so as to stimulate the appetite, many feeders regard rice properly prepared as the finest of all for this purpose, as it is cooling to the blood, easy of digestion, appetising, and produces fine flesh. The method of preparation is important, as it must be cooked. To each gallon of rice should be added three gallons of water, and three

pounds of broken graves or meat scrap, and simmered (not boiled) until the rice has swollen and absorbed all the water, which it will do in two or three hours. It is broken up, allowed to cool, and will be eaten with avidity. For variation Indian (or corn) meal mixed with thirds or pollard may be used. In that case the graves or meat scrap should first be boiled, and then, with its liquor, be mixed with the meal, making a crumbly, friable mass. Too often the importance of green food is forgotten. A supply, if available, should be fed every day. Nettles, boiled and mixed with the food, are excellent. Fresh lettuces are also good, but not always obtainable. Cabbages make an excellent substitute. Green food cools the blood, and keeps the birds healthy. Grit must also be supplied freely. It is necessary to point out that the system indicated is only for birds that are to be killed, and is too forcing for those destined to be breeding stock.

Killing and Packing.—As in the case of chickens, ducklings should be starved for twenty-four hours before they are killed. Dislocation of the neck is the best method. A barrel should be provided with slots cut in the top, in which one leg of each bird is placed, allowing it to hang head downwards after the neck is broken for one or two minutes, so that the blood may drain well from the body. They are then plucked completely, except the wings and head and two inches down the neck. The wings are turned upon the back, and the birds laid upon a flat board or table with the breasts upwards, the heads hanging over the side. As soon as half a dozen are thus treated, another wide board is laid along the breasts and weighted. They should be allowed to remain until thoroughly cool, which will vary in accordance with the temperature, and then be carefully packed in baskets or hampers holding a dozen, in which they are embedded in clean straw. Packing ducklings whilst still warm is a fatal mistake, and means that they will arrive at their destination green and depreciated in value. As far as possible each lot should be even in size and general appearance.

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CHAPTER XXXII

RACES OF DOMESTIC GEESE.

CHAPTER XXXII

RACES OF DOMESTIC GEESE.

ROMAN.	CANADIAN.
EMBDEN.	RUSSIAN.
TOULOUSE.	EGYPTIAN.
SADDLEBACK, OR POMERANIAN.	CHINESE.
DANUBIAN.	AFRICAN.

The geese generally found in Europe and America possess a remarkably uniform character, varying only to a limited extent, less than met with in any other domestic poultry. Until a comparatively recent period there were only two breeds generally known, the Grey and the White respectively. That was the case in Italy nearly 2,000 years ago. Gervasse Markham, whose work on 'The English Husbandman' was published in 1615, says: 'Now, for the choyse of geese, the largest is the best, and the colour would be white or grey, all of one pair, for pyde are not so profitable, and blacks are worse.' 'Pyde' geese probably meant parti-coloured, like the Pomeranian. Blacks are now unknown. It is probable that these referred to very dark grey.

Numerous references are found in writings throughout the centuries before and after the commencement of the Christian Era to the domestic goose, indicative of the fact that it was common among live stock, and was widely distributed. Robinson states (1) that when Cæsar invaded Britain in the first century A.D. tame geese were kept by the natives, a further proof that they were more advanced in civilisation than has generally been supposed. We have not been able to trace the record, but do not question it. An interesting fact that two thousand years ago and more the methods adopted in breeding and control of these birds were not very different to those seen at the present time.

Within comparatively recent years some additions have been made to the races of geese regarded as valuable for domestic purposes by introductions from other countries. There is, however, very little development in respect to feather coloration, doubtless due to the homely garb of the parent stock, as whites and greys predominate. It is true that rather more coloration is found in African and Asiatic geese. Even with these there is a lack of brilliancy of plumage which characterises some other races of poultry. The goose appears to have been early domesticated. It was a sacred bird in Eygpt 4,000 years ago—Priests have always been fond of good living, and kept this as far as possible to themselves. During the ages external characters of the goose have been modified very slightly, probably due to the utilitarian nature of these birds, as they are useful more than ornamental. Darwin emphasises the fact that (2) 'hardly any other anciently domesticated bird or quadruped has varied so little' as the goose. Nor only was it valuable for its flesh but provided quills for writing. Hehn says (3): 'The first quill pens were used at the commencement of the Middle Ages, in the time of the Ostrogoth Theodoric. It is now supplanted by the steel pen, so that there are three great periods of such instruments—the earliest, lasting from the beginning of the art of writing among the Egyptians to the fall of the Roman Empire, being that of the split reed, used by Thucydides and Tacitus; the second that of the quill pen, with which Dante and Voltaire, Goethe, Hegel, and Humbolt wrote; and the third that of the steel pen of the nineteenth century.' Goose feathers have been valued for the making of beds for 2,000 years.*

ROMAN.

Nomenclature: *English*, Roman; *French*, De Romagne; *German*, Italiener; *Italian*, Di Romagna; *Spanish*, Romana, or Italiana.
Varieties: White, Black and White.
Classification: Dual Purpose.
Colour of Flesh and Skin: Creamy-white.
Colour of Legs and Feet: Reddish-grey.
Colour of Egg-shells: White.

Observations made in various countries, and especially in Italy, have led to the conclusion that some, at least, of our modern races of geese can trace their descent to those which were domesticated in the Italian peninsula prior to the Christian Era. Italian races of fowls

*Plate XCVIII.

have exerted great influence in the evolution of many breeds. Distribution, as we have already shown, has followed political and military changes. To the dominion of the Roman arms and the commercial relationships of Italy with other parts of Europe may be attributed the dissemination of the goose, modified by domestication of the wild species in the respective countries. Throughout South Germany, Austria, Hungary, and the Balkan States, is found a white goose, partaking of the Embden in character, but much smaller in size, and resembling the White Roman goose. Formerly this was thought to be an Embden. The conclusion we have arrived at is that it is descended from the Roman, for which reason it may be regarded as the oldest European breed.

Origin.—Upon this point no direct evidence is available, which is scarcely to be expected in connection with a breed that has existed for twenty-three centuries. Doubtless it was obtained by selection when its wild progenitor, the Greylag, was captured and brought into the service of man. Among the ancient writers many references are made to geese in Italy before the time of Christ. Hehn (3) says: 'Among the Romans perfectly white geese were carefully selected and used for breeding, so that in course of time a white and tamer species was produced, which differed considerably from the grey wild-goose and its descendants.' Homer, Livy, Lucretius, and other ancient writers, mention both white and coloured geese. These birds were kept in the Capitol at Rome as sacred to Juno, which, as in Egypt, meant that the priests retained them for their own use as far as possible.

History.—The goose is famous for its preservation of the Roman Capitol during the siege by the Gauls, 365 B.C. The assailants in the night climbed to the summit in silence, not even alarming the dogs. 'They were not,' says Livy, 'unperceived by some geese, which, being sacred to Juno, the people had spared, even in the present great scarcity of food, a circumstance to which they owed their preservation, for by the cackling of these creatures and the clapping of their wings Marcus Manlius was roused from his sleep,' and the Capitol was saved. From that time onwards the goose has held a definite place in the affection of the Romans. In modern times it has not been bred to any great extent. Mid and Southern Italy are not as suited to the production of fine flesh as are Lombardy, Piedmont and Venezia, or the colder parts of Europe.

Economic Qualities.—Roman geese are very precocious, rapid in growth, and prolific layers. For the production of early goslings, for which there is a good demand at profitable prices, this breed is invaluable. The geese are very late sitters. The goslings grow rapidly, and are quickly ready for the green gosling trade. The older birds moult quickly and their feathers are valuable. In meat qualities, whilst the flesh is somewhat dry in their native land, under cooler and more favourable conditions it is excellent, and the birds fatten extremely well. At six months they weigh 8 to 9 lbs., and three months later 12 to 14 lbs. For these smaller birds the demand is large. The Roman goose is a splendid forager, and on range finds practically all its own food.

Description.—The body is long and broad, with a well-developed sternum ; breast broad yet not very prominent, thus resembling the Embden ; back broad ; neck long, fine and arched ; head fine, in some specimens with a small crest at the back of the head ; eye blue, surrounded with bare skin of pale yellow ; beak very thin and short, nearly rose in colour, with a tip of ivory-white ; wings large, not carried far back ; legs strong, reddish-grey in colour, with white toe-nails ; the general appearance is a well-developed goose, not so upright or large as the Toulouse or Embden. Weight : males 10 to 14 lbs. ; females, 8 to 12 lbs.

Varieties.—In Italy the Roman and Padovarna are classified separately. They are evidently of one race, not two distinct breeds. We, therefore, place them in the same category.

ROMAN.—Pure white in colour, close and compact in plumage.

PADOVARNA.—In this variety the greater part of the plumage is white. In the gander especially the head, back of neck, wings, and sometimes the back, are dark grey.

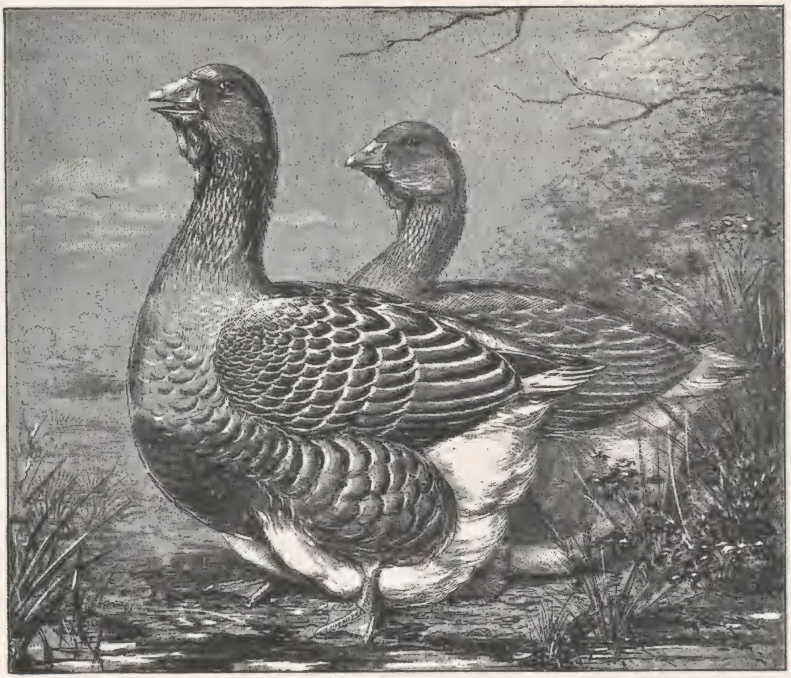
EMBDEN.*

Nomenclature : Embden, Embdener, or Bremen.
Variety : One.
Classification : Table.
Colour of Flesh and Skin : Creamy-white.
Colour of Legs and Feet : Bright-orange.
Colour of Egg-shells : White.

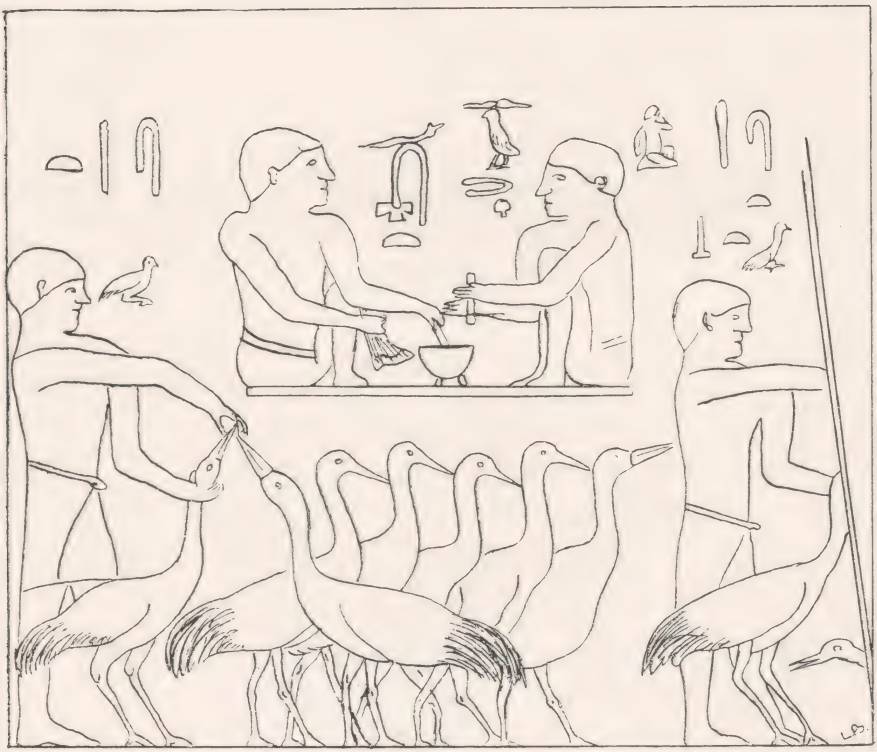
Origin.—White geese have been bred for many centuries in Western Europe, either sports from the Grey or introduced from Italy. The

*Plate XCIX.

PLATE XCVIII



TOULOUSE GEESE



FATTENING GEESE IN ANCIENT EGYPT
(From Tablets in the Pyramid of Sakkara)

Embden, as now known, appears to have been bred on distinctive lines for about a hundred years. In the early part of the Nineteenth Century white geese were common in Britain and Ireland. The great improvement which has taken place—for it is generally admitted that to English breeders is due the credit for this fine race—was the result of bringing over a larger type of white goose from Holland and Western Germany, in the latter of which especially large white geese have been bred. As stated by the Author (4) geese of this type are extensively bred on the great plains of Hanover, Westphalia and Oldenburg, where the finest specimens are produced. There is also an off-shoot of the Embden named the Diepholz, which has been specially bred as a winter layer, coming into profit in September, and enabling goslings to be marketed in the winter and early spring.

It is evident that the present-day Embden is the result of crossing the German White and the English White geese. In this connection may be noted that many English Embdens have been exported to Germany for the improvement of the native breed, and that the stock found on both sides the North Sea are closely allied.

History.—How the name Embden came to be given is not recorded. That town is the centre of a district where geese breeding is extensively carried out. Probably stock was imported thence and the term adopted to distinguish from the English White. The first use of the name we have traced was in 1838, after which time it became general. At an earlier date geese of this variety were exported to America under the name 'Bremen,' by which they were known for a considerable period, the designation doubtless indicating the port from whence they were shipped. In Britain and America alike they have won favour for their economic qualities.

Economic Qualities.—The Embden is quiet in temperament and amenable to control. The goose is an early layer, generally coming into profit in February. They are persistent sitters and mothers, but do not lay as many eggs as the Toulouse, which is a non-sitter. The eggs are large, protected by a hard, thick shell. They continue as layers for many years. It is desirable not to use them for breeding until they are two years old. The leading quality of the Embden is rapidity of growth, which is an important point in its favour, more especially for the green gosling and autumn goose trade. Hence they

can be brought into condition for killing at small cost, especially if fed off upon the stubbles. If kept until Christmas they fatten well and attain large size. They are hardy, good foragers, thriving upon poorer lands where the Toulouse would not be so profitable. The feathers are of greater value than those obtained from grey geese, which to some extent accounts for their popularity.

Description.—The body is long, broad, and thick, with a massive breast, not carried in front as in the Toulouse, in comparison with which it has a somewhat flat appearance; there is no sign of keel, and the body is tight and compact; the paunch and stern are full and deep; wings very large and powerful; neck long and fine, well arched; head straight, broad, and strong; bill short, and thick at the base, in colour orange; dew lap or loose gullet should be apparent; eye large and full, bright blue in colour; tail straight, rather short; legs and feet very stout in bone, with straight toes, bright orange in colour; plumage pure white. Weight: English Standard, males, 30 to 34 lbs.; females, 20 to 22 lbs.; American Standard, males 18 to 20 lbs.; females, 16 to 18 lbs. In Britain size has been carried to an extreme for exhibition, though in that respect a reaction has taken place.

TOULOUSE.*

Nomenclature: In most countries Toulouse; *Italian*, *Spanish*, Tolosa.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: Pale Orange.
Colour of Legs and Feet: Orange.
Colour of Egg-shells: White.

Origin.—Grey geese have been known since the species was domesticated. All the earlier English writers from Gervasse Markham refer to these. It is evident that whilst the wild grey has been used in the production of the Toulouse, other influences were brought to bear in improvement of size. There can be little doubt that this was obtained from Southern France. In the early part of last century geese were extensively bred in the Haute Garonne Department of that country, of which Toulouse is the capital. In recent times the number kept in that district is greater than in any other French Department save one, Dixon assumes (5) that the Toulouse goose 'is only the common

*Plate XCVIII.

domestic, enlarged by early hatching, very liberal feeding during youth, fine climate, and perhaps by age,' which is not supported by the facts of the case, although the various influences have each had their share in evolution of our present stocks. In the fourth decade of last century the then Earl of Derby imported for his famous menagerie at Knowsley some grey geese, as did others, from Southern France. These were called at first Mediterranean or Pyrennean. Finally, however, the term Toulouse was adopted. From these birds, carefully selected, our present-day stocks have descended. It is generally acknowledged that the English is finer and larger than the French Toulouse.

History.—The importation of the Toulouse geese named was immediately prior to the establishment of poultry shows, which latter led to greater perfection of type, and to increase of size. White geese are more general than the grey by reason of more rapid growth. The Toulouse is chiefly used for crossing.

Economic Qualities.—The goose of this breed is a good layer, seldom becoming broody. It is not a reliable sitter and mother. The eggs are large, generally white in colour of shell. Goslings are somewhat slow in growth, for which reason they should be hatched early. They are not of much use as green goslings, or for killing in early autumn. They thrive well on good soil, but do not forage freely. If properly treated they develop large frames, and when fatted attain big weights. The flesh, however, is coarser than that of the Embden, and the proportion of bone and offal is high. Their loseness of skin and abundance of feather, with frontal prominence gives them the appearance of greater size than is really the case. Frequently the Embden will exceed the Toulouse in weight at Christmas, with the added advantage of fitness for killing about Michaelmas, when the latter is in lanky condition. A large paunch is undesirable. The Toulouse is a heavy eater. They are hardy, vigorous, and not disposed to wander far from home. For crossing they are valuable. Many of the best market specimens are Embden-Toulouse.

Description.—The body is long and very deep, carried low between the legs, and very prominent in front, having a keel almost level with the ground from breast to paunch, which latter is usually heavy and carried low; back broad, slightly curved, and shoulders broad; neck

long and very thick; head broad and thick, with strong bill, orange in colour; it forms a uniform curve from point of bill to top of head; eye large, dark in colour; on the throat is a heavy dewlap, often exaggerated in show birds, leading to weakness and disease, and indicating a loose skin; tail high and full; legs short, heavy in bone, toes well spread, colour orange; back, wings, and thighs are of a dark, even steel-grey, each feather laced with a much lighter shade, almost pure white, except the flight feathers, which are of a solid steel-grey; breast and under parts are of a clear grey, lighter on the thighs; stern, paunch, and tail are white, with a band of grey across the tail. Weight: English Standard, males, 28 to 30 lbs.; females, 20 to 22 lbs.; American Standard, males 20 to 26 lbs.; females, 16 to 20 lbs. The general appearance is that of massiveness and great depth of body.

SADDLEBACK OR POMERANIAN.*

Nomenclature: *English*, Saddleback; *German*, *Dutch*, Pommersche; *French*, Pomeraine; *Danish*, Pommerske; *Spanish*, Pomerania; *Hungarian*, Pomeràniai.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: Pale Orange.
Colour of Legs and Feet: Orange-red.
Colour of Egg-shells: White.

Origin.—Part-coloured geese were formerly more common in Britain than is now the case. In Germany these have been bred on distinctive lines. In that and other continental countries they are fairly common. In some of the earlier works on Poultry, mention is made of what are called Mottled Geese, by which name the Saddlebacks were designated. In the 1854 edition of Moubray (6) it is stated that 'as we are satisfied that they are the production of the White (or Embden) with the Grey (or Toulouse), and have now very generally established themselves with us, it may be well, perhaps, to concede them the honour of a passing notice. In size they are of fair proportions, and differ but very slightly from those previously described, save in the plumage, in which white predominates, mottled in patches with a greyish-brown, only irregularly. The geese of this kind most valued, as well for their appearance as utility, are what have long been known as "Saddlebacks," so called from a large broad patch of the dark feathering upon the back and wings.' In Germany this race has been bred for a long time, is widely distributed.

*Plate C.

PLATE XCIX

EMBDEN GOOSE

DANUBIAN GOOSE

History.—The Saddleback has been produced and bred entirely for utility. The characters are more or less fixed. It is widely distributed in European countries, more especially Germany and the south-east.

Economic Qualities.—The Saddleback goose is a moderate layer a good sitter and mother. These birds are not very rapid in growth. When fully developed they carry a considerable quantity of flesh on the breast, which meat is excellent in quality, fine in texture, and soft. The birds are hardy, excellent foragers, and specially suited for flat and low-lying lands, where they can wander at will. Water is necessary for them, and the breed is not to be recommended for high and dry lands. Goose breasts, so largely eaten by Germans, is produced extensively in Pommerania.

Description.—In shape the race follows closely the Toulouse, except that they are higher on the leg; body even, long, very broad, with a full, well rounded breast, and deep behind; back broad, slightly arched; neck of medium length, strong, and carried erect; head broad, of medium length, and strong, with a thick, stout bill, almost in a line with the top of the head; the bill is orange-red in colour; tail broad, carried almost horizontally; legs stout with thick bone, of medium length, and toes slender; colour of legs and feet orange-red; wings powerful, full, of medium length; the geese are generally pure white; the gander has a grey head and neck, back and wings, and in many cases the coloured feathers are spotted or laced with white. Weight: males, 18 to 22 lbs.; females, 15 to 20 lbs. These are for birds eight to nine months old. Adult specimens approximate to the Embden. In Germany and other countries both sexes are three to four pounds lighter.

DANUBIAN.*

Nomenclature: *English*, Danubian, or Sevastopol; *French*, Frisee, or Sebastopol; *German*, Lodengans; *Italian*, *Spanish*, Danubio.
Variety: One.
Classification: Table and Feathers.
Colour of Flesh and Skin: Creamy-white.
Colour of Legs and Feet: Red.
Colour of Egg-shells: White.

Origin.—No information is available as to the origin of this race of geese. They are widely distributed in the countries surrounding

*Plate XCIX.

the Black Sea. From the appearance it may be assumed that the Danubian is a variation from the ordinary white goose, perpetuated by reason of the larger amount of plumage, as feathers are an important consideration in Eastern Europe. During visits paid to Hungary and the Balkan countries numbers of birds with loose feathers were met with in the regions of the Lower Danube.

History.—These birds were first known to British Breeders at the time of the Crimean War, and the earliest specimens imported are stated to have been received in 1859. Whether these birds came from Sebastopol, as the name then given implied, is not known. Later the name Danubian was adopted. We have not had opportunity of visiting Roumania and Bessarabia, which form the delta of the river Danube, and cannot say whether this breed is common there. Goose breeding is extensively followed.

Economic Qualities.—The Danubian goose is quiet in temperament, indisposed to wander far, and fattens very easily. It is also a good forager, finding a large part of its food. It is a moderately good layer, and a very reliable sitter and mother. The flesh is excellent, having that softness when fed off, without being greasy, which is a recommendation on the table. In western Europe it is occasionally seen in exhibitions, but not kept for food production. The feathers are valuable by reason of the natural curl.

Description.—In body these birds are long as compared with their depth, more like the shape of a duck. The line is level with the ground; neck of medium length, fine for a goose; head like that of the Embden, except that the bill is rosy red, as are the legs and feet; eye bright blue. The peculiarity of this breed is that the wing and back body feathers are elongated like streamers, frequently trailing on the ground; these feathers are slender, often curled, and as they are not webbed the birds present a somewhat draggled appearance. Another result is that the birds do not fly. They are active walkers and swimmers. Weight: males, 10 to 11 lbs.; females, 8 to 9 lbs. In colour the majority of specimens are pure white, and are the more pleasing in appearance. We have, however, seen many on the Continent of Europe in which grey or light-brown patches were present. In these the colour of the plumage is uncertain. The White Danubian has been fixed by careful selection. It is recorded that among the

PLATE C

Arsamas (Fighting) Goose

Pommeranian or Saddleback Goose

earlier imported birds a few had a small tuft on top of the head. We are informed that many birds having that decoration are met with in Southern Russia and Asia Minor.

RUSSIAN.*

Nomenclature : *English*, Russian ; *Dutch*, Russische ; *Danish*, Russiske ; *Spanish*, Rusa ; *Hungarian*, Orosz.
Varieties : Tula, Arsamas, Kholmogory.
Classification : Fighting, Table.
Colour of Flesh and Skin : Yellow.
Colour of Legs and Feet : Dark Orange-yellow.
Colour of Egg-shells : White.

Origin.—The first English reference we have been able to trace as to the fighting geese of Russia is in the eighth edition of Moubray (7) in which he states that at St. Petersburg ' they have no cock-pits, but they have a goose pit, where, in the spring, they fight ganders, trained to the sport, and so peck at each other's shoulders till they draw blood. These ganders have been sold as high as 500 roubles each.' A short reference is made in Cornevin's work (8) to the Tula goose, under the term ' Race de Combat.' Our acquaintance with these birds, which are the most striking of the species in individual character, began in 1899 at the exhibition held that year in the Russian Capital. We have, however, not been able to obtain any information as to their origin. M. Houdekow says (9) that ' the only established fact is that this race has been bred in Russia from a very remote period, and that they have preserved their typical and fixed character.' The conclusion is that the type is entirely artificial, is not the result of natural selection, and has been developed by man for his own sport.

History.—These fighting geese, especially the Tula and the Arsamas, have been bred in Mid-Russia to the south of Moscow, and in the region of the Upper Volga river. Formerly they were kept by the great landowners to a very large extent, as these were the dominant factor in the old Russian Empire. They have passed with the Revolution. Goose fighting was then a recognised sport. The breeding of first-class specimens was a profitable pursuit, as was Game Fowl breeding in Western Europe and America. With prohibition of the sport, although much fighting took place surreptitiously, the breeding

*Plate C.

declined. So far as known this class of goose is not met with in any other part of the world, is peculiarly Russian in character, and, as already stated, is artificial in its special characters, for although ganders of other breeds are often keen fighters, they are not naturally disposed to sustained combat, except in defence of their mates or young. It is stated that these birds are as keen for battle as are Game cocks, and that the females encourage them to redoubled effort.

Economic Qualities.—Keeping in view that these varieties of the goose have been specially bred and trained for fighting, it will be understood that weight of body and great strength of muscle are essential to success. Hence follows development of the wings in order that heavy blows may be struck meant increase of the breast muscles. Thus, as in the Game fowl, the meat properties were unintentionally enhanced. M. Houdekow refers to the fighting breeds as follows (9):

'Our geese are indebted for their existence to the sport of goose-fighting; nearly all our races of geese are fighters. The principal quality which has secured their appreciation is the faculty of fighting each other furiously; until one of the combatants is dead the other will not leave the field of battle. These geese are not very productive. Thirteen eggs per annum is the usual record, but sometimes birds produce twenty eggs. These geese have remarkable endurance, and do not require any special food or care. Their flesh is of an excellent quality, is not fibrous, and is very fine in flavour. It is impossible to fatten fighting geese to the same degree as the Toulouse or Embden, but their flesh has a good taste, more like that of wild game. They are good sitters, and are very careful of their young, defending them against all species of birds and animals.'

Our own observations in Russia support what is here stated, except that for general purposes the flesh is hard, and the birds require to be well hung after killing before they are cooked. Thus their chief economic value is for crossing, as in the case of Game and Cornish fowls, with soft-fleshed breeds, under which conditions the results are evident in an abundance of breast meat of fine quality. Difficulties must necessarily arise in the case of birds in which the pugilistic nature is so highly developed, due to their quarrelsome nature. Where single males are kept for crossing that would be reduced to a minimum. The

use of Russian geese with other breeds is worthy of a trial for the development of meat qualities.

Description.—The races of Russian geese named above are similar in general characteristics. The body is long, broad, and very deep, with a full, round, and massive breast, and a wide, flat, straight back; neck of medium length, very strong, and slightly curved near the head, which latter is the peculiar feature of the breeds, entirely distinct from that of any other bird with which we are acquainted; it is short and nearly round, with a wide forehead, well developed cheek muscles, and in older birds there are often two knobs or protuberances, which increase in size with advancing age, on the upper part of the skull; bill very short indeed, stout at the base, the line of the upper mandible being in a line with the front of the head, which, together with the bill, is practically the same length as depth, in conformation resembling the head of a bull-dog; beginning with the nostrils the surface of the bill is ribbed, and the mouth, between the upper and lower mandibles has a rounded appearance, seeming even when closed to be partially open; the colour of the bill is pale yellow, with an ivory tip; eye large, full, and nearly black, as a rule, but in some specimens the pupils are grey or light blue; wings very large and powerful, with strong shoulder muscles; tail short; legs of medium length, very strong, well set apart, with large round feet, and in colour dark orange-yellow. These birds are built on powerful lines, and are close and compact in plumage and flesh.

Varieties.—Tula.—These, the best known, are chiefly bred in the central districts of Tula, Kalonga, Tamboff, Kizan, Koursk, Vladimir, Nijni-Novgorod, and upon the borders of Oka and the upper regions of the river Volga. They are generally grey in plumage. Some are also clay-coloured. Weight: 13½ to 17 lbs.

Arsamas.—Pure, spotless white in plumage, and larger in size of body, as they range from 17 to 22 lbs.

Kholmogory.—This variety has a longer neck, and the bill is more natural, being of ordinary length; the upper line of the bill is curved at the end, giving it a hooked appearance. They are used for fighting, though not to the same extent as the Tula or Arsamas. This is the largest race, weighing 20 to 25 lbs.

CANADIAN.

Nomenclature : *English*, Canadian ; *French*, Cravate.
Variety : One.
Classification : Table.
Colour of Flesh and Skin : Creamy-white.
Colour of Legs and Feet : Black.
Colour of Egg-shells : Dull yellowish-green or white.

Origin.—The great naturalist Cuvier was doubtful as to whether this goose was related to the swan or to the goose. That has been decided by interbreeding between the wild American and the domestic goose. It is undoubtedly descended from the wild goose which migrates from Central to North America, and which at one time was shot by servants of the Hudson Bay Company in the far north, thus contributing to their supply of food in winter. The wild specimens when captured readily adapt themselves to domestication, breeding freely with tame geese.

History.—Mr. John H. Robinson (1) quotes references to these birds from books as far back as 1801, and states that at the first Poultry Show in America, at Boston in 1849, they were exhibited. In the American Standard of 1888 the name Canada Goose was applied. The breed was formerly bred to a greater extent in Canada and the United States than any other variety. Within more recent years it has been displaced by other races. In Europe it has been mainly kept for ornamental purposes.

Economic Qualities.—The chief value of the Canadian goose is for crossing to improve the vigour and flesh qualities of the domestic breeds. They have an abundance of highly-flavoured meat which is exceptionally fine in texture. They are hardy, quick growers when bred in the ordinary manner, retaining, however, a large measure of their wild nature.

Description.—The body is long and somewhat slender, with a full, deep breast, and long, rather narrow, well-curved back ; neck long, slender and swan-like ; head small, as is the bill, the latter sharp at the tip and entirely black ; wings large and powerful ; tail strong ; legs long, with straight toes, black in colour ; body colour, head, neck, wing primaries, and tail, black ; back and wings greyish-brown, lighter at the edges ; breast light grey ; under parts of body greyish-white ; flanks pale grey with white lines ; in front of the neck around

the throat and across the chin is a broad white band, which extends behind the eyes, giving the French name of Cravate. Weight: males, 12 to 16 lbs.; females, 10 to 14 lbs.

EGYPTIAN.

Nomenclature: *English*, Egyptian, or Nile; *French*, d'Egypte; *German*, Nilgans; *Dutch*, Egyptische; *Danish*, Aegyptiske; *Italian*, Egitto; *Spanish*, Egipcio.
Variety: One.
Classification: Ornamental.
Colour of Flesh and Skin: Dark.
Colour of Legs and Feet: Yellowish-pink.
Colour of Egg-shells: Grey or buff-white.

Origin.—These birds are widely distributed in Africa, and may be found in a wild state from Egypt to Cape Colony. They have been domesticated in the regions of the Lower Nile for thousands of years. Representations are found on sarcophaga and tablets among the monuments of ancient Egypt.

History.—In the long past the goose was a sacred bird in Egypt. During later centuries the Egyptian goose has been constantly domesticated, and is fairly amenable to civilised conditions. It is, however, chiefly kept in other countries on estates and in Zoological Gardens, not for production.

Economic Qualities.—The Egyptian goose is a good layer, breeding well in semi-confinement. The ganders are very savage and do not consort amicably with other races of poultry, appearing to delight in annoying any animal or bird within reach. They will fight continuously if more than one male is in a flock. The goslings grow rapidly, and the race is hardy in the extreme. The flesh, which is fairly abundant, is dark and full in flavour, improving considerably when the birds have been bred and fed under domestication for a few generations.

Description.—The Egyptian stands easily first for beauty of plumage among the various races of geese. The body is long, small and slender, with a round yet not deep breast, and narrow, slightly arched back; neck medium in length and fine; head small and long, with a bill in keeping, usually purple or reddish-blue, with a grey tip; eyes orange, and around the eye is a ring of reddish-brown or chestnut, a band of the same colour passing down the nape of the neck; wings large,

armed with a short spur; tail full and stiff; legs long, slight, in colour yellowish-pink, with straight toes; in plumage colour the breast and under are a light iron-yellow sprinkled with brown, except the abdomen, which is white; back and inner wing feathers are grey marked with black; flights and tail black or metallic green, the former having a rich narrow bar; neck grey and black with a clear ring of reddish-brown. Weight: males, 8 to 10 lbs.; females, 6 to 8 lbs. In carriage these birds are upright and graceful.

CHINESE.

Nomenclature: *English*, Chinese; *French*, Guinée; *German*, Hockergans; *Dutch*, Chineesche; *Danish*, Kinesiske; *Spanish*, China.
Varieties: White, Brown.
Classification: Dual Purpose.
Colour of Flesh and Skin: Yellowish.
Colour of Legs and Feet: White, Orange; Brown, dusky-orange.
Colour of Egg-shells: White.

Origin.—Goose breeding is very extensively practised in China. Very little is known as to the breeds found in that country. Mr. Lewis Wright says (10) that 'the original Chinese variety ranges all over China, much of Siberia, and most of India, but chiefly Northern India.' He did not, however, give any authority for this statement, and appears to have followed Cuvier, who called it the Swan goose, stating that it is frequently met with in Tartary and China. It was called Siberian by Linnaeus. Other naturalists have testified that the majority of geese seen in India owe much to the influence of the Chinese goose. In all probability it is an ancient race, domesticated by the Chinese many centuries ago. It does not appear to have been modified to any great extent more than is usual under domestication.

History.—A most interesting fact is given by John H. Robinson (1) who states that 'The earliest record of Chinese Geese in America is in the correspondence of George Washington, and was first published in Haworth's "George Washington—Farmer" in 1915. It discloses that in 1788 he received from Gouverneur Morris two Chinese Pigs and with them "a pair of Chinese Geese, which are really the foolishest geese I ever beheld; for they choose all times for setting but in the spring, and one of them is even now (November) actually engaged in that business."' He surmises that these were probably white as that colour was well known in Virginia early in the Nineteenth Century.

Apart from the writings of naturalists the first special attention of British breeders of poultry was called to this race by Dixon, who stated that in 1848 Mr. Alfred Whittaker, of Beckington, Somerset, owned a flock of White Chinese which (5) ' were from imported parents, and were hatched on board ship from China ' ; and also that another breeder in the same county had a number of specimens. The China goose had been previously known under other names, as referred to by Buffon, Cuvier, Bewick, etc., and possibly by Willughby.

The writer just named says : ' It has enough names to fill a menagerie—China goose, Knob goose, Hong-Kong goose, Asiatic goose, Swan goose, Guinea goose, Spanish goose, Polish goose, Muscovy goose,' and, as we have seen, Siberian goose. Willughby stated that in the seventh century it was usual to apply the term ' Guinea ' to everything of foreign and uncertain origin. It would appear what we now term the African was included, for Dixon was told by the head keeper of the Zoological Society in 1848 that there were three varieties, namely, the White and two types of Browns. For various reasons the Chinese goose has never been popular in Europe. In America it has commanded greater favour.

Economic Qualities.—The Chinese goose is regarded as an excellent layer. In an American report is stated that (11) ' the Brown and White Chinas are early and prolific layers of fair-sized eggs. If well fed they not infrequently lay in the autumn months, but generally those who do so lay later and fewer eggs the following spring. At the Experiment Station in 1896 and 1897 the White Chinese laid in every month from January to June inclusive, while the Brown Chinese did not begin laying until February, but continued laying freely into June.' The highest records were fifty eggs from one White goose and forty-two from a Brown goose. The eggs are not so large as those obtained from Embden and Toulouse. The claim that the flesh qualities are equal to other races of geese does not appear to be warranted. In the report already referred to is stated that ' China geese are not favourites with those who raise goslings for sale to poultrymen, who fatten them and put them on the market as green geese. They are too small to be profitable for such a market. When a small-boned, moderate-sized goose is required for the fall or Christmas trade, these breeds would prove valuable, as they lay well, and with proper care in

selecting breeding stock large birds should be raised. The Brown Chinese especially seem very vigorous, hardy, and active, but pick hard, and require care in dressing to look well. The White China . . . is usually not so difficult to pick, and handsomer in appearance when dressed.' The chief value of the White Chinese is for crossing, to produce a smaller-sized goose to meet the requirements of the autumnal market. Smaller birds often meet with greater demand than the very big specimens. Chinese geese are very hardy, and make good sitters and mothers, but are somewhat quarrelsome, and have a rather unpleasant cry.

Description.—The body is of medium length, round, plump, and is carried upright, the chest being well elevated; breast round and fairly full; neck long and arched; head carried well forward, and is large and long, with a large knob at the base of the bill; bill stout and of medium length; eyes large and bright; tail hard and stiff; wings large, well folded; legs medium in length, with long, straight toes. Weight: males, 12 to 16 lbs.; females, 10 to 14 lbs. In Europe dewlaps are permitted, but not in America.

Varieties.—The two classes are very uniform, except in coloration of plumage.

White.—The plumage is pure white, except that there is often a colour stripe from the head to the body; the bill, knob, and legs are orange in colour, and the whole appearance is pleasing.

Brown.—The body colour is a greyish-brown, shading to white or very light grey on the abdomen; the head is dark brown, and the front of the neck and breast a yellowish-grey or brown, with a very dark brown stripe passing from the back of the head down the neck to the body; wings and tail are dark brown; bill and legs dusky-orange, and the knob black or dark brown.

AFRICAN.

Nomenclature: *English*, African; *Dutch*, Africaansche; *Danish*, Africanske; *Spanish*, Africana.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: Yellow.
Colour of Legs and Feet: Dark Orange.
Colour of Egg-shells: White.

Origin.—This race has been made known by American breeders, who have accorded it a separate classification. In spite of the fact

that claim has been made for it as a distinct breed, on the ground that it is supposed to have first been imported from Africa, that it is said to be bred in the neighbourhood of Zanzibar, and that possibly the name 'Guinea' given to the Chinese may have had some justification, it cannot but be regarded as a descendant of the last named breed, as there is not the slightest proof of the distribution of either wild or tame members of the family on the African continent. It is essentially Chinese in character, varying principally in size, and may be regarded as a descendant of the Brown Chinese goose, crossed probably with some other and larger variety such as the Toulouse. Specimens may have been taken to Africa by trading-ships and afterwards to America. Whether the crossing to secure increased size and thicker body took place in Africa or America is unknown; probably the latter. Hence the line of descent would be:

History.—Whether Buffon's 'Spanish' goose and those variously designated by other writers were Chinese, or African, or both, cannot be determined. In England, as already seen, there were in 1848 three types under the name of Chinese. The first reference is in an American work (12) published in 1847 where the term Guinea or African was used. From the description it evidently relates to what is now called African, in that it is stated the breed 'is the largest of the goose tribe . . . and it often weighs more than 25 pounds.' It is recorded that (11) Mr. William Rankin, of Brockton, Mass., said he first knew of the African in 1859, when some were landed at Essex, Mass., U.S.A. 'What he learned from persons who had them led him to believe that they came from Hindustan, and he called them Indian geese, and all pure bred were called by that name. He next found geese landed by a Provincetown (Mass.) vessel, and said to have come from Africa. These birds were scattered about the section west of Boston, and were called Africans, and exhibited under that name.' They have never attained any measure of popularity.

Economic Qualities.—Evidence as to egg productivity is very conflicting. In the Rhode Island experiments, 1897, the highest

record was twenty-two, and the lowest fourteen. The eggs are larger than those of the Chinese. Their chief point is flesh quality, as birds grow rapidly, make excellent green goslings, and fatten to a great size for the winter trade. They are hardy, of a quiet, mild disposition, and contentedly accept restricted conditions when fattened.

Description.—The body is long, large, and deeper than the Chinese, but is not carried so erect, following the Toulouse type; neck moderately long, fairly thick, and well curved; head large, with a long, stout bill, which is black, as also the prominent knob at its base; wings large and powerful; legs stout, of medium length, dark orange in colour, with black nails on the toes. The colour of body on the back, wings, and tail is dark grey; on the breast and under-parts light grey; the neck is light grey, with a dark brown stripe from the head down the back of neck to body.

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CHAPTER XXXIII

GOOSE FARMING.

CHAPTER XXXIII

GOOSE FARMING.

REASONS FOR DECLINE—REDUCTION OF DEMAND—SIZE OF GEESE—PLACES FOR GEESE—HOUSING GEESE—HATCHING—REARING—FEEDING GOSLINGS—FATTENING—GERMAN METHODS.

Whilst in the various branches of Poultry Husbandry there has been great advance during recent years, one has shown a marked and steady decline, namely, that of goose-breeding. This is almost universal. For example, in England and Wales during the last forty years the number of geese upon farms has decreased by 37 per cent. The same tendency is evident in other countries.

Reasons for Decline.—Of what is here stated there are two explanations, first of which is that the raising of geese is essentially a business where are wide areas of land over which these birds are able to roam, finding almost all their food in the doing so. As cultivation has increased the numbers of geese have declined. Such has proved to be the case in France, Denmark, Northern Italy, as in Great Britain and Ireland. Prior to the Great War of 1914-18 great quantities of geese were raised annually in Germany, Russia, and South-eastern Europe. As yet production has not assumed the former scale. With enclosures in all countries the opportunities for profitable goose-breeding are correspondingly reduced. Farmers have found that they could turn their cultivated fields to more profitable advantage, especially as geese are thought to do damage to crops and fine pastures. In Britain at one time arable farmers in many cases bought annually a flock of goslings for putting on to the stubbles. The declension of grain growing explains why the imports of lean live geese from Ireland and the Continent of Europe, once an extensive trade, has become very limited. Farmers know their own business. In view of lower returns,

and lessened demand, the margin of profit by such system disappeared. There is no evidence of any change in that respect.

Reduction of Demand.—Formerly there was a great demand for the geese as an article of food during the Autumn and at Christmas. That was one of the treats of the festive seasons. Goose clubs once flourished, enabling those of moderate means to indulge to this extent, and the sale was considerable. Such is not now the case. In multitudes of households a goose is not seen upon the table from one year end to another. To some extent this change was due to differences in taste, and to demand for other classes of meat, but also to the fact that goose flesh is expensive by reason of the comparatively small amount of meat upon the body. In Germany is a higher consumption of goose flesh than in any other European country, which is stimulated by the practice of dividing the bird and selling it in parts.

Size of Geese.—Throughout Northern and Western Europe breeding of geese has been with the object of marketing birds of large size, often ranging up to 25 lbs. and over. Throughout Southern and Eastern Europe the type of geese generally met with are much smaller. During visits to Southern Germany and Hungary we found on the markets plump, fleshy specimens, weighing in the late summer 8 to 9 lbs., which commanded a ready sale. These birds are within the purchasing ability and the needs of modest householders. Poulterers state that in later days demand is for much smaller birds than was at one time the case. How far introduction of the Roman goose and races of a similar type would rehabilitate the goose in popular favour is a question for consideration.

Places for Geese.—The universal experience is to the effect that for the profitable breeding and raising of geese these must be kept on commons, moors and what are more or less waste lands, where these birds can wander at will and obtain nearly all their food supplies. A most important point is that the cost of food must be kept down to the lowest amount compatible with health and growth. Where conditions are favourable, and the land is of moderate quality, nothing more than a little grain or meal at night is necessary to supplement what has been obtained naturally during the day. In very dry seasons, however, more is required, and especially in the shape of succulent greenstuff. Where the number kept is sufficient it is desirable to

engage a boy to drive them to their range and tend during the day. A good house should be provided with plenty of straw for bedding. Although a pond or stream is not imperatively needed, access to water in this way is conducive to the well being of stock geese. The writer can remember how at one period many labourers raised small flocks of geese upon the common lands.

Housing Geese.—Usually upon farms where geese are bred there are permanent buildings which can be allotted to them. Otherwise it is desirable to erect one of a suitable character. Whatever the house it should allow of 10 square feet of floor space for each inmate, and be 7 ft. 6 in. to the eaves, whether it be a lean-to or gabled. The advantage of a special erection is that the front can be formed of bars, so that there is complete ventilation, helped by louvre openings in the gables. If a permanent building, there must be abundant openings in front. Dryness is essential. Although geese are water-fowl, dampness is fatal. For that reason the floor should be above the level of the outside ground. Inside, the floor should be littered with straw or dried leaves, either of which forms a very valuable manure with the excretions of the birds. These sleep upon the floor. If the birds are supplied with food in the evening, they will return there regularly.

Hatching.—As a general rule young geese commence to lay about the middle or end of February, and older birds a month later. For the production of breeding stock the more mature birds should be used. If, however, early goslings are desired, the former may be mated. If the strain is a good one—strong and not inbred—eggs from younger geese may be hatched, the drawback being that the goslings are not so quick in growth as those from older stock. In no case should these be kept for breeding. With white geese, if eggs are allowed to remain in the nest, as soon as about fifteen are laid the mother will evince a desire to sit. If removed regularly she will generally produce nearly twice as many before showing any sign of broodiness. Under those conditions the usual plan is to place the surplus under large hens, giving four to each. Geese are often thought to be clumsy, but such is not our experience if they are given a large nest easily entered and left. When under hens the eggs should be regularly sprinkled with water to soften the shells. Geese are known to lay two clutches of eggs in one season, if bred early, and are from a good strain.

The time of incubation occupies thirty days. The nest should be in a quiet, yet open place. It should not be disturbed, except in case of accident, as geese are very spiteful and pugnacious. If her mate be near, it may be dangerous to do so, as the males resent interference. A regular attendant may overcome this difficulty. The goose should be fed on oats and have plenty of water within reach when she comes off the nest.

Rearing.—Food and water must be supplied when hatching is completed, so that the mother may satisfy her appetite. The gander is very attentive, and the pair will attend to the goslings, which are the easiest of domestic poultry to rear. Once hatched they need little attention. When hatched they should be accommodated in roomy coops or crates, 30 inches square, to which small runs or yards may be attached. These should be placed in a sheltered position, as direct sunshine is fatal to the goslings. Where there are trees or bushes the coop should be under their shade, otherwise some shelter must be improvised, the best form of which is made of hurdles into which furze, or even straw, has been interlaced. As goslings are unable to hold their feet on a wooden floor, and are very apt to injure themselves, the coop should stand on the ground. As a rule goslings are not hatched until the weather is open and mild, and they are hardy by nature. When ten days old the run may be removed, and the goose will lead them in foraging. About three weeks it is necessary to remove mother and flock to a house where they will have a greater amount of space.

Feeding Goslings.—Goslings grow very rapidly, to which end they must have an abundance of feed, whether natural or artificial. The main object is to build up a strong frame on which the flesh will afterwards be laid. The best feed is barley meal, or corn (maize) meal and whole wheat. The grain should be scalded and dried up with the meal. When about two months old raw grain and sliced potatoes will become the staple diet. At this stage maize is the cheapest feed. Goslings are very fond of young grass, especially plentiful at that season of the year, green onions, chickweed and early cabbages. Unless there is a natural supply of water available this must be supplied freely.

As the fields are cleared of their crops the young goslings should be given access to them. Where the number is sufficient they must be

in charge of someone to prevent their wandering too far. A lad can keep them in order, and drive them home at night.

Economy in feeding is of the utmost importance in connection with geese and goslings. The chief dependence should be upon what can be obtained naturally, otherwise the costs will be excessive in comparison with the returns. During the growing stage, especially where the herbage is good and during a fairly moist summer, with the exception of a little food—say any good meal made into a paste when first liberated in the morning, not even that if the conditions are favourable, and a few oats, or wheat, or maize, steeped and fed in the evening—they can obtain all they require. Geese are essentially grass eaters, as is indicated by the structure of the beak. Any supplied food should be to make up for deficiencies in, and not take the place of natural food. That is the reason why these birds should only be raised where there is free range. Should the summer be very dry more must be given. That should be as far as possible in the shape of fresh, green stuff.

Fattening.—Geese are gregarious and do not thrive if isolated. They appear to be miserable if denied the company of their fellows, losing weight rapidly. That applies to the fattening as well as the growing stages. So far as Michaelmas geese are concerned these come into plump condition if they are allowed to forage on the stubbles after harvest, or may be fed on roots. For winter consumption they are better if enclosed within small runs in each of which is a good and roomy shed with open front, twenty to thirty in each flock, selected to be as even as possible in size. The food supplied should be soft in the morning and steeped grain in the later afternoon, as much as they will eat. Fresh water in abundance must be available. The soft food may be any good meals, inclusive of maize meal and thirds, or shorts, and the grain whatever is available at a reasonable price. Oats make the finest and most mellow flesh. Maize produces bulk, but there is considerable loss in cooking by reason of the amount of oil derived from that grain. Plenty of grit must always be at hand. Geese should always be dry picked. The system of scalding is most objectionable as it spoils the appearance and causes the flesh to be flabby.

German Methods.—In Germany the consumption of goose flesh has been greater than in any other country, varying from the goose

breasts of Pomerania to the *pâté de foie gras* for which Strassburg, now included in France, has been famous. As a result of greater prosperity due to industrial development, and advanced purchasing power, as well as increasing population, demand grew in the decades preceding the Great War to an enormous extent. To provide for this vast quantities of live birds were imported from Russia. In the vicinity of several of the great cities we have visited fattening plants, in one case with accommodation for 30,000 geese at one time. Special goose trains brought annually in three-decked wagons the live birds which were sold to the fattening establishments. These were well equipped with large roomy sheds, plucking, chilling and packing rooms. Smaller specimens were fed three weeks, in which time they increased in weight by 4 to 5½ lbs. Larger birds were fed for four weeks, and increased by 6¾ to 9 lbs. The conditions in pre-war days are fully described in the Author's "Report on the Poultry Industry in Germany," published in 1912.

CHAPTER XXXIV

RACES OF DOMESTIC TURKEYS.

BRONZE AMERICAN TURKEYS

(By courtesy of "Poultry Tribune," Mount Morris, Ill., U.S.A.)

CHAPTER XXXIV

RACES OF DOMESTIC TURKEYS.

BLACK.	AMERICAN BRONZE.
WHITE.	NARRAGANSETT.
GREY.	FAWN.
CAMBRIDGE BRONZE.	ROQUIÈRES.

In Chapter I evidence is given that the Turkey was first imported from America in 1500. One French writer states that (1) the first birds were seen in France in 1518. John Walcot, whose book on British Birds was published in 1789, says that the Turkey was introduced into England in 1521. Dixon (2) gives the date as 1524, which is generally regarded as correct. Martin Doyle says (3) that 'according to the "Norfolk Archæology" an ancestor of Sir George Strickland, Bart., first brought it into England, and the crest (grant of arms given to William Strickland by Edward VI, about 1550) of this family is a turkey cock in his pride "proper." . . . In 1541 Archbishop Cranmer prohibited the appearance at table at State festivals of more than one dish of turkey cocks; the female was too precious to be cooked at that period. Fourteen years later two turkeys and two turkey poults were served up at a grand law dinner. Twenty years afterwards the turkey became a Christmas dish with farmers.' In Sir Anthony Fitzherbert's 'Boke of Husbandry' (1523) no mention of the turkey is made. Old Tusser, however, writing in 1573 of the Christmas fare of the period, says:

'Beef, mutton, and port, shred pies of the best,
Pig, veal, goose, and capon, and turkey well drest.'

Barnaby Googe, in his 'Four Books on Husbandry,' in 1578, says, 'Turkey cocks we have not long had among us; for before the year of our Lord 1530 they were not seen with us, nor, I believe, known to the old writers.'

Gervasse Markham, in 'The English Husbandman,' published in 1615, deals with the turkey as a recognised denizen of the poultry-yard. It is evident that this bird spread rapidly over Europe. Belon's description was published in 1555. An interesting account has been given as to its introduction into France which is erroneous (4), suggesting that the first turkeys were shipped from Boston in 1576 and used at the wedding feast of Charles IX. and Elizabeth of Austria, as a result of which the monarch named began to breed turkeys in the forest of St. Germain.

In Italy the first recorded account is of the year 1556, when an ordinance was issued by the magistrates of Venice repressing the luxury, and about 1570 Bartholomew Scappi, cook to Pope Pius V., published several recipes for cooking them. It is further stated that they were first introduced into Germany in 1580.

The turkey had evidently been domesticated for a considerable period at the time of discovery of America. It is easily understood, therefore, that so large a bird would rapidly advance in favour by reason of this fact, and the quality of the flesh.

BLACK.

Nomenclature: *English*, Black Norfolk; *French*, Dindon Noir; *German*, Truthühner Schwarz; *Dutch*, Kalkoenen Zwart; *Danish*, Kalkun Sorte; *Italian*, Tacchini Nigripennis; *Spanish*, Negra de Pavos; *Hungarian*, Oulyka Fekete.
Varieties: Black, Black Norfolk.
Classification: Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Slaty black.
Colour of Egg-shells: Cream, speckled with brown.

Origin.—The Mexican turkey, whilst it cannot be termed black, for there is a considerable amount of brown in the plumage, is dark in colour, and has a constant tendency—as, in fact, have the Bronze—to black feathers, more especially under new conditions. As there was no other race with which the early imported turkeys could be crossed, it is more than probable the earliest importations were dark in plumage. It may be that selection for that colour had been general in Central America before the discovery of that country. A further point is that the Spaniards prefer black-plumaged poultry, as that colour is protective against too much sunlight.

History.—There is no information as to the distribution of Black Turkeys. Senor Castello (5) says that the black variety is chiefly found in Andalusia and Castile. In Northern France many of the turkeys are black. At one period throughout East Anglia what were termed the Black Norfolk were common, and evidently had been bred there for a very long period. Their place has been taken by Bronze, due to the greater size and vigour of the last named breed. In other European countries than those named Black are very general, more especially in Germany, Austria, Hungary, and the Balkan States. These are frequently called Bronze. Personal observations have shown that these are much more allied to the Black than to the Bronze American. Eastern European turkeys are, as a rule, much smaller in size than those found in western countries and in America. The diminution of size would appear to be most apparent the further the species has travelled from its natural habitat.

Economic Qualities.—That the Black turkey is one of the finest in flesh qualities is generally admitted. It yields a large amount of beautifully white, soft flesh, which is fine in flavour, whilst its lightness of bone is a distinct advantage. These—as, in fact, all—qualities are due in large measure to the conditions under which they are produced. The finest specimens of black have been met with on the rich lands of Eastern England, and of Normandy, in France, where climate, soil, and natural food are conducive to quality of flesh. In Mid-Europe turkeys are smaller in size, and have not the same quality of meat, whilst in Southern and South Eastern Europe, with exceptions, the flesh is dry owing to the climatic conditions. Of the Black the French are much the hardier, whilst the Norfolk have become almost extinct. The hens are excellent sitters and mothers.

Description.—The breed is long in body, very deep from back to sternum, full and round in front, with a broad back, which is curved, high in the centre, with a stern much lower than the shoulders; neck long and curved, carried well back; head long and broad, what is known as carunculated, which means that the head and upper part of the neck are bare of feathers, the skin wrinkled, and formed into wart-like elevations. From the base of the upper mandible springs a fleshy protuberance capable of elongation, with a few hairs at the tip, and taking the place of a comb as in the domestic fowl. The head is

blue on top, back, and face, wattles and caruncle bright red; beak stout and well curved, dark horn in colour; eye full and dark hazel; wattles full, round and pouch like; wings very large, long, and powerful, carried low in the male; the tail of the male is very large, and spreads out like a fan; that of the female is long but compact; legs and feet are stout and strong, but not heavy in bone, and, with the toes, are long, in colour, dark lead or slaty-blue. Weight: (in England and France) males, 20 to 22 lbs.; females, 12 to 14 lbs.; (in America) males, 18 to 27 lbs.; females 12 to 18 lbs.

Varieties.—Whilst all the Black are allied, there are differences which require to be mentioned.

FRENCH.—These are of a deep, glossy, even black throughout, without any white or brown tips. During the breeding season they are very handsome.

NORFOLK.—It is generally stated, although some older writers do not agree in this respect, that the Norfolk Black is dull in colour, without any sheen. The chief difference between these and the French is that some of the feathers in the tail and on the back have brown, or even white tips, probably due to influences to be noted later. For the restoration of this fine old breed the French Black would be most valuable.

WHITE.*

Nomenclature: *English*, White; *American*, White Holland; *French*, Dindon Blanche, *German*, Virginische; *Dutch*, Wit; *Danish*, Hvide; *Italian*, Tacchini Bianchi; *Spanish*, Blanca; *Hungarian*, Fehèrpulyka.
Variety: One.
Classification: Table, Exhibition.
Colour of Flesh and Skin: Reddish-white.
Colour of Legs and Feet: Pinkish-white.
Colour of Egg-shells: Cream, speckled with brown.

Origin.—Given black-plumaged birds as the basis, it is easy to explain the origin of the White Turkey. There is always a tendency by failure of pigment to white when breeding black-plumaged birds. Tegetmeier says (6) 'It is well known that most birds, wild as well as tame, occasionally produce perfectly white individuals of more delicate constitution than the parents. There can be no doubt that the selection and pairing of such is the way in which the breed of white turkeys has been established and kept up.' This writer mentions the

*Plate CII.

PLATE CII

White Turkeys on Hungarian Farm

frequent production of ticked or speckled specimens in flocks of Whites, and an American breeder, Mr. J. A. Leland, says : (6) ' As to colour I have never seen a White Holland turkey that did not show some black ticking in its plumage during some period of its life,' which is a further evidence of the origin.

History.—White Turkeys have been known for a long period of time. Moubray and other of the earlier writers refer to them, and that author states that they are said to have been originally imported from Holland. (7) The countries where they are chiefly seen are France, Austria and Hungary. In the South of France, more especially Languedoc, Provence, etc., they are almost exclusively kept, and are regarded as hardy and fine in quality. Lewis Wright mentions (8) that ' the Whites are often mentioned as Austrian Whites—why we do not know, as they can be traced back in England for over 100 years.' Our personal observations in that country, also in Hungary, prove their wide distribution in Southern Europe. In America, the White Holland, as it is called—probably owing to birds having been taken from the Low Countries to the States—has attained a limited amount of favour. In Britain they are chiefly kept for ornament or exhibition. The finest display we have ever seen was at Presburg, or Pozony, Hungary, now Czecho-Slovakia, in 1902. On a later visit we saw them in large numbers on the plains of the Danube. The white plumage explains much of their popularity.

Economic Qualities.—In France the claim is made that the White turkey is equal to all others for flesh qualities. In Hungary we were informed by a large dealer that they do not kill or dress as well as those with dark feathers. English experience in this respect is unreliable, from the fact that the breed is not kept for market purposes. They are said to be delicate, which may be due to inbreeding and keeping under unnatural conditions. In Hungary they are said to be as vigorous as the Blacks. The hens are fair layers, good sitters and mothers.

Description.—In general character the Whites are the same as the Blacks, excepting that the beak is flesh-coloured with a pink tinge, and the legs and feet, which are pinkish-white ; the plumage is a glossy white, with the faintest indication of blue, thus proving they are not albinos. The beard, or tuft of feathers on the upper part of the breast

in male birds, is black. The contrasts are very pleasing, and this is the most beautiful of the turkey family. Weight : males, 20 to 28 lbs. ; females, 14 to 18 lbs.

GREY.

Grey-plumaged turkeys have been known for almost as long a period as any other colour. That is to be expected where Blacks and Whites are bred. The Greys have never assumed definite characters, and have not been regarded as a distinct race. Older writers on poultry frequently refer to this colour, and it would appear that at one period these were common in Cambridgeshire. One writer says (9) speaking of turkeys in Norfolk, 'When grey they are called the Bastard breed.' In the South of Ireland many turkeys are grey in plumage. The wonderful quality of flesh upon these, probably the finest in the world, raises an enquiry why Irish breeders have not fixed the characters and elevated them into a distinct race. In that case the Grey would command a high position. Increase of size, however, would be desirable, for the present birds of grey colour are usually small. Italian turkeys are also grey in hue. They are even smaller than the Irish and, so far as our experience has gone, are dry and insipid in flesh, due to the conditions under which they are bred, and the intense Summer heat of Eastern and Southern Italy. Turkeys with blue or slate-coloured feathers are often met with, more especially upon the Continent of Europe, as might be expected where Greys and Blacks are common. Occasionally we have seen very pretty specimens. These variations are interesting, though at present of no breed value. Better results would be obtained by perfecting the Grey turkey than in attempting to secure slate-blue colour, as in the Andalusian fowl.

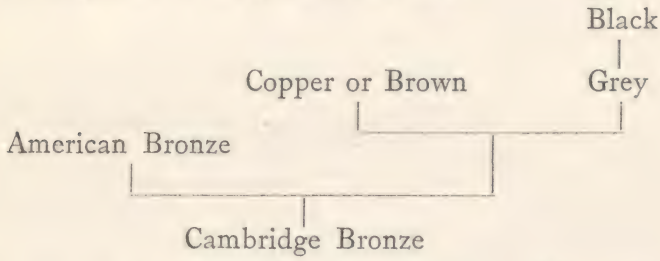
CAMBRIDGE BRONZE.

Nomenclature : *English*. Cambridge Bronze ; *French*, Dindon de Cambridge; *Dutch*, Cambridge Brons ; *Danish*, Bronse-favede Cambridge ; *Spanish*, Cambridge Bronceada ; *Hungarian*, Cambridge Bronz.
Variety : One.
Classification : Table.
Colour of Flesh and Skin : White.
Colour of Legs and Feet : Dark Grey.
Colour of Egg-shells : Cream, speckled with brown.

Origin.—Cambridgeshire has been as famous for its Turkeys as Norfolk. The character of the races bred in the two countries has

differed considerably. Dixon says (2) that 'the plumage of the Cambridge breed varies very much; sometimes it is entirely made up of shades of reddish-brown and grey . .. sometimes of grey, black, and white, but frequently it approaches very near to what we see figured as the wild bird.' It is stated by Wingfield and Johnson (9) that 'they vary in colour, being grey, pied white and white, and rusty brown. . . . The grey breed is the one most common in Cambridgeshire, being considerably hardier than the others. Attempts have been made to cross this breed with the white and black breeds; but in every instance within my knowledge these attempts have signally failed. As a proof of the excellence of the Cambridgeshire turkey, it may be remarked that that country has for several years supplied the Royal table on Christmas Day.' In the 1854 edition of Moubray mention is made of Grey, of Copper, and of Brown turkeys, as all found in Cambridgeshire. After the period named, either by crossing of American Bronze, or more careful selection of darker-plumaged birds, they assumed more or less of a Bronze character, as in 1865 the Cambridge turkeys exhibited were of a dull bronze. Then arose a demand for size and greater vigour, and the Americans were freely used for breeding.

The following table of descent may be regarded as representing the development of the present-day birds:



Even yet can be distinctly traced the Grey influence.

History.—In the mid years of the Nineteenth Century the Cambridge turkey was recognised as the finest of the larger races. It yet holds the premier position in that respect, although not so extensively bred as formerly. It is unequalled on the markets. At exhibitions it is seldom seen, the more homely garb of these birds appearing dull besides the American Bronze, which latter secure the leading prizes.

Economic Qualities.—Some of the chief turkey raisers still regard the Cambridge Bronze as the best. It is comparatively light in bone, and is abundant in flesh. Although not so large as the American Bronze they fatten better, producing soft flesh of great thickness, beautifully white in colour. These birds have not the prominence of breast bone as seen in other breeds, and are plumper. The largest specimen we have seen was one weighing 33 lbs. dead. It was tender as a chicken, without the heavy bag in front which is evident on other races. It is not in these days as hardy as the American Bronze. The hens are good layers, and excellent sitters and mothers.

Description.—The type is that general to the species, except the Cambridge is not so long in body, yet is deep and massive ; the plumage is of a dull bronze, with grey and white tips to the body feathers, and bars on the wings and tail of the same colour ; the beak is flesh-coloured, and the legs and feet dark-grey ; in size these birds do not equal the American. Lighter frame, however, is an advantage when the birds are fattened. Weight : males, 18 to 24 lbs. ; females, 12 to 16 lbs.

AMERICAN BRONZE.*

Nomenclature : *English*, American Bronze ; *French*, Dindon Bronze et Cuivres ; *German*, Bronzefarbig ; *Dutch*, Amerik Brons ; *Danish*, Amerikanske Bronse-farvede ; *Italian*, Selvaggia d'America ; *Spanish*, Bronceada Americana ; *Hungarian*, Amerikai Bronz.
Variety : One.
Classification : Exhibition, Table.
Colour of Flesh and Skin : White.
Colour of Legs and Feet : Very dark, or flesh-coloured.
Colour of Egg-shells : Cream, speckled with brown.

Following upon the settlement of what is now known as the United States and of Canada, the turkey has been a favourite in those countries, so much so that Benjamin Franklin, on the separation of the North American States from the British Crown, desired it to be made the national emblem rather than the eagle. What was the exact type of turkey bred under domestication in the earlier years of last century is uncertain. It is more than probable there had been a constant infusion of wild blood. Mr. H. S. Babcock states (10) that ' there is reason to believe that it (the American Bronze) resulted from crossing the wild turkey—the original of all the domesticated varieties—upon the Black Turkey. Early references to the variety show that it was at first known as the " Black Bronzed," but the term was too long

*Plate CI.

and it was shortened into Bronze. This variety is interesting as showing that, after a marked departure from the early colour, it has come back to very nearly the colour of its wild original. The Black has departed a long distance from the rich hues of the wild turkey, but the lines are restored in the Bronze variety.' In a report published by the Rhode Island Experiment Station the statement is made that where wild turkeys are plentiful crosses between wild and domesticated birds frequently occur without design on the part of the owner of the latter. Scores of cases are recorded where a wild gobbler from the woods has taken possession of a flock of common turkeys, sometimes after first battling with and killing the domestic gobbler. The results of such a cross in almost every instance have been so satisfactory that such matings are much desired by turkey-raisers in those districts, and young birds are caught for the purpose and brought up with the ordinary flocks. Nests of wild turkey eggs when found in the woods are hatched on the farms. Hence the origin of the Bronze American turkey is explained. As, however, human population increases the opportunities in this direction are becoming fewer in America, and are non-existent in other parts of the world.

History.—There is no actual record as to when these birds became general in America, probably that was 200 years ago. The first importations into Europe appear to have been in the early part of the Nineteenth Century, when Lord Leicester in Norfolk, Lord Powis in Wales, and Lord Derby in Lancashire, bred specimens in a wild state. The birds were only partially tamed, and were kept with considerable difficulty. These awakened great interest. Their real value was not realised until the latter half of the last century when the turkey began to displace beef and the goose as the Christmas dish, and the demand for huge specimens arose. From that time onwards they have grown in popularity, displacing other breeds. Upon the Continent of Europe so-called Bronze turkeys are found. Unless imported for show purposes these are duller in plumage and are smaller in size than the American. They are usually crosses of the Blacks with the older Copper-feathered or Red varieties.

Economic Qualities.—The chief qualities of the American Bronze turkey are its great size and, under proper conditions, greater vigour than any other member of the species. With the demand for large

specimens in America for Thanksgiving, and in Europe for Christmas, for which high prices are paid, the popularity of this breed is explained. Twenty-five to thirty-pound young males of eight and nine months old can be produced, and usually command a higher price per pound than smaller specimens. The breeder has sought to supply that which yields the greater profit. There has, however, been a reaction against the bigger birds. The Bronze carries a large amount of breast-muscle. In fineness of texture, delicacy of flavour, and whiteness of skin, it is not the equal of the Black, or Grey, or Cambridge Bronze, although superior to the South European birds. Much, however, depends upon the nature of the soil, general conditions, and feeding. They are somewhat heavy in bone, and show a heavy bag in front when killed. The birds of this variety are somewhat wild in temperament, and range widely. If allowed to roost in the trees during the greater part of the year they thrive well. The hens are good layers, excellent sitters and mothers. The chicks are hardy if the parents are well matured before these are used for breeding, and when the broods are reared in a common-sense manner. Coddling is a mistake. As a cross the American Bronze stands pre-eminent where size of progeny is desired. When killed the breast bone is usually very prominent.

Description.—The body is long, well rounded, and deep midway, rising sharply to both back and front; back and body are very broad, the breast prominent and wide; neck long, curved, and heavily clad with feathers; head long and broad, with a strong, curved beak of horn colour; the carunculations in the male are very full; eyes dark hazel; wattles long and pendulous; wings large, powerful, wide-spreading, with massive muscles, enabling the bird to rise; tail in the male is very long, and when the bird disports himself is spread into a huge fan; legs long, stout in bone, and in young birds almost black, turning to flesh-colour with increasing age; in colour the neck and breast are of a rich, brilliant bronze, with a narrow band of black at the extremity of each feather; the primary feathers of the wings are nearly black, with pencillings of grey or white, but the secondaries are more brown or bronze. When spread the appearance is that of equal bars of bronze and grey; wing-bows a lustrous black; tail feathers are black, across which are narrow bands of light brown, with a broad band of black, and a wide grey margin at the tips. The hens are

similar in body to the males, but not so brilliant, and, of course, have not the spreading tail. Weight: Males, 25 to 36 lbs.; females, 16 to 20 lbs. The heavier specimens are generally less reliable for breeding purposes. Two year old birds are preferable at 26 lbs. for males, 16 lbs. for females. The statement has been made that in America old wild turkey cocks have been shot weighing 60 lbs.

NARRAGANSETT.

Nomenclature: Narragansett.
Variety: One.
Classification: Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Deep salmon or brown.
Colour of Egg-shells: Cream, speckled with white.

Origin.—It is stated that this race has been bred for a long time in the New England States, more especially Rhode Island. The name is taken from that of the bay which stretches from Newport to Providence, Rhode Island. It is probable that it is descended from a darker breed of turkeys, possibly brought from Mexico.

History.—Formerly turkeys of this type were ubiquitous in the district named above. Mr. H. S. Babcock says (10) 'It is the variety which, in all probability, first gave to Rhode Island turkeys their world-wide reputation. That reputation has remained, although the variety has to a considerable extent disappeared from the breeders of the bay. The greater size of the Bronze turkey has been a potent cause in the gradual disappearance of other varieties.' So far as known they are not widely distributed. We have never seen any in Europe.

Economic Qualities.—Much less in size than the Bronze the claim is made that the Narragansett turkey is finer in quality of flesh, which is softer, and they are not so heavy in bone, maturing more rapidly, and meeting the demand for medium-sized, fleshy birds. They are not regarded as equally hardy. The hens are good layers, but do not make satisfactory sitters, as they are late in becoming broody. They do not wander far.

Description.—Lacking the massiveness of the Bronze this breed is shortish in the leg, compact and cobby in body. The plumage is of a metallic black, each feather ending in a broad, light steel-grey band, edged with black; the flight feathers are black, barred with white or grey, showing two narrow bars when folded; the tail of the male is

black, barred with brown, and terminating in a broad black band, with a light grey margin; the hens' plumage is much paler and duller; beak light horn. Weight: males, 20 to 25 lbs.; females, 14 to 18 lbs.

FAWN.

Nomenclature: *English*, Buff or Fawn; *French*, Chocolate; *Italian*, Fulva.
Variety: One.
Classification: Exhibition, Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: Bluish-white, or flesh-colour.
Colour of Egg-shells: Cream, speckled with brown.

Origin.—Specimens of Buff, or Fawn, or Chocolate turkeys, for they vary greatly in colour, are to be met with in several European countries, and are to be found in America. That these are merely sports from the Bronze, due to crossing with the White, appears to be evident. Upon this point Mr. H. S. Babcock writes: (10) 'How it perhaps originated can be guessed, though we have no records to tell us the matings or the maker of the matings. But as black-red domestic fowls crossed upon white produce an approximation to buff, which, by selection, can be perfected, we believe that a cross of the Bronze and the White turkey, with subsequent selection, would produce the Buff variety.

In older books references are made to this colour, which are always stated to be scarce. A few are met with in exhibitions at home and abroad.

History.—The writer just quoted states (10) that 'a variety of the Buff turkey used to be found in Pennsylvania, U.S.A., under the name of Tuscawawara Reds. These birds had a deeper buff than the ordinary Buff.'

In the 1854 edition of Moubray it is stated that these buff turkeys, 'with plumage of a light buff or delicate fawn colour, have an exceedingly neat and Quaker-like appearance when the shade is unbroken, but it is sometimes broken with white. This colour is but rarely met with now.' When, as already noted, Copper or Red turkeys were by no means infrequent, Buffs would be produced. They are, however, kept for their rarity rather than for production.

Economic Qualities.—Very little information is available, for the reason stated above. In size they correspond to the White, and equal that breed in meat qualities. They are fairly hardy. Birds which

are primarily bred for exhibition are often inbred, more especially when the plumage colour is so difficult to obtain and maintain as is buff, and where the conditions are largely abnormal.

Description.—The shape of body is that general to the species. The desired colour of plumage is pure buff, or light fawn, or a deeper red, almost chocolate, in accordance with the depth of pigment. Any one of these shades is pleasing in appearance when it is sound. Specimens are seldom found which do not show variations in depth of colour, or are free from what is called patchiness, that is, lighter patches over the body, and, as a rule, the under colour is paler, as are the wings. The best we have met with were those of a darker hue, called chocolate in France. Even with these the colour was not even. The beak is bluish-white, or flesh colour; in many cases the tail feathers are very dark. Weight: males, 18 to 20 lbs.; females, 12 to 16 lbs.

RONQUIÈRES.

Nomenclature: *Belgium*, Dindon de Ronquières.
Varieties: Several.
Classification: Table.
Colour of Flesh and Skin: White.
Colour of Legs and Feet: White.
Colour of Egg-shells: Cream, spotted with brown.

Origin.—This race of turkey has been bred extensively in Belgium, and appears to be due to an admixture of breeds without any reference to coloration of plumage, as the economic qualities are the primary consideration. From the appearance we judge that the basis is the French Black. With that it would seem there has been crossing of the Grey and the White. It is possible there has entered into it some measure of Bronze influence. All, however, is uncertain, as no evidence is available as to the mating. Size of body, wealth of flesh, white legs and feet, have been the leading points aimed for by breeders, who were desirous of securing fine market turkeys, capable of attaining heavy weight in a comparatively short period of time, and yielding the largest profit. Such uniformity of character as has been obtained is due rather to selection on these lines. 'Handsome is as handsome does' has evidently been the prevalent idea in the minds of those concerned in the development of this race.

History.—In the early years of the present century efforts were put forth to fix the Ronquières as a distinctive breed of turkey. Upon

the usual lines it can hardly be said to deserve that position, as the variations are considerable even in the same brood. As stated in report of a Belgian flock (11): 'The breeding pen is composed of a turkey cock and five or six hens. The male is very large, and of a dark colour; the plumage of the hens has no uniformity—each has a different plumage.' Later breeding upon more definite lines has taken place, which is essential if the economic qualities are to be fixed and transmitted. In that respect selection of the male is of the utmost importance.

Economic Qualities.—The Ronquières turkey is noteworthy for its flesh properties. It is a quick grower, carrying a large amount of meat on the breast, which is fine in texture, soft, and beautifully white in colour. In size they do not attain the proportions of the American Bronze. They are larger than the white; respond well to fattening. The hens are good sitters and mothers, and are regarded as hardy, more especially as they are bred and reared under somewhat rough and ready conditions.

Description.—The following description is by the late Louis Vander Snickt (11):

'The typical colour (of the male) from which are derived all the secondary colours, is a dark grey and dull tawny; each feather, of which the centre is pencilled with fine black concentric lines, is bordered with a black bar showing brilliant metallic reflections. The edges of the feathers of the stern, the abdomen, and the tail are white. The hens are of all colours imaginable, even yellow; yellow with each feather edged with black; grey; Whites with each feather edged with black; pure White, and combinations the most diverse. But whatever the plumage may be, the feet are always white, with white toenails, signs required in all fowls to produce fine white flesh.'

We have met with some specimens which were as follows: the males were very dark, well marked with yellow and black, which latter was very bright and predominating; the hens were of a grey ground colour, with one dark bar on each feather. The breed is capable of improvement in respect to characteristics.

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CHAPTER XXXV

TURKEYS AS FARM STOCK.

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RANGE FOR TURKEYS—FAVOURABLE CONDITIONS—STOCK BIRDS—AGE AND BREEDING STOCK—SIZE OF DOMESTIC TURKEYS—NUMBER OF HENS TO MALES—HOUSES AND ROOSTS—HATCHING—REARING—FEEDING—TURKEY POULTS—FATTENING—KILLING AND DRESSING.

As indicated in Volume I, it is now more than 400 years since the turkey was first introduced into western Europe. For various reasons it speedily became a favourite dish with the wealthier members of society. This was not alone by reason of the fact that it was different to any other class of poultry, but also that the meat is fine in quality and abundant. Until the latter half of the nineteenth century, it was much more a luxury dish than is now the case. The demand for turkeys at festive seasons, notably Thanksgiving in America and Christmas in Europe, is now very large. In fact, throughout the winter months, it is always in profitable demand. There has been, however, a tendency to decrease of supplies by reasons which are indicated below. One result is that prices have advanced, and in those countries where there has not been full restoration from the effects of the Great War, many people who would otherwise buy turkeys are unable to do so.

Range for Turkeys.—Many attempts have been made to adopt more intensive methods for turkey raising, in some of which it is claimed that success has been attained. A notable fact, however, is that up to the present time, intensive methods, whilst these may have proved temporarily successful, have not developed. From this may be assumed that these have not given an assurance of that permanency which is necessary for the building up of any industry. So far as we are aware, there has been no instance in Europe where any other than what may be termed natural methods have justified themselves. In

this connection is a most interesting fact, namely, that in several of the United States, where at one period turkey raising was carried out extensively, there have taken place outbreaks of disease as a result of which what were at one time great turkey producing districts are no longer so. During visits which the Author has paid to some of the chief centres in the New England States, no other conclusion could be arrived at than that this result was due to tainted soil following the keeping of birds in greater numbers than the land occupied warranted. On farms visited it was revealed that where there was abundance of range for the total number maintained and bred, the practice was generally of keeping near to the homesteads so that the soil became "turkey sick" and great mortality followed, due to "blackhead" and other diseases. Experience in Europe has supported this view.

Although we have been unable to discover why the turkey is less amenable to semi-intensive conditions than are other classes of poultry, the fact remains that such is the case. Attempts are constantly being made in the opposite direction. So far as present knowledge is concerned, it may be accepted that abundance of space is desirable for these birds and that turkey raising is more suited to those who occupy large or medium-sized farms than upon small occupations. Under suitable conditions where sufficient range can be given, there is no branch of farming which can be made to yield a greater amount of profit. The number, however, of turkeys must be relative to the amount of land available, and it is desirable that such land should be cultivated in a regular manner.

Favourable Conditions.—This is an aspect of the question upon which there has been considerable diversity of opinion. An impression is very general that turkeys are delicate. This has been deterrent to many. No doubt it is correct that, at certain stages of growth, the young birds require very careful attention, apparently to be due to the fact that they have much less self-reliance than have chickens or ducklings. The cause, in our judgment, is capable of explanation. These birds can withstand cold, and even rain does not affect them to the extent which is sometimes imagined. Those who propose taking up turkey farming must consider the nature of the soil. Damp land would be fatal. European experience is to the effect that medium

lands, namely, such as are neither too heavy nor too light, but which are fertile, produce the finest turkeys. The better the land, provided that it is medium in its nature and well drained, the better the turkeys will be, and the less trouble will have been given to the owner. That is especially the case where the district is hilly or undulating for there the natural drainage is generally good. Valley lands, which might otherwise be useful, are often damp, due to insufficient drainage. Wherever turkeys are bred there should be plenty of natural shelter, for which reason bare, open lands are less desirable for this purpose.

Briefly stated, it may be accepted that turkeys must have plenty of range and that the nearer we can get to nature, the better the results will be. In favour of this contention may be said that there is no need to force growth and that as the season of demand is mainly restricted to the autumn and winter months, the most essential factor is that a good frame shall be built up on which the flesh can be laid by fattening later on. In some instances, a measure of success has been achieved by breeding turkeys in a semi-wild state. The stock was placed in woodlands. No interference took place, they bred when and where they liked, and as the numbers increased beyond a certain stage or when any birds were wanted they were shot. That system was not commercial, and whilst it is useful to supply breeders with vigorous males, it is expensive and could not become profitable.

Stock Birds.—For size and quality it is necessary to depend very largely upon the male turkey. Hence the necessity for careful selection. To purchase a cheap bird, lacking in vigour and size, would be false economy. In this respect may be noted that a male will serve a dozen or a score of females and be the progenitor of all their poults for that season. If, by lack of size or weakened constitution, the poults of one turkey hen when matured are a pound below the average, the owner loses the return for, say, 12 pounds ; but if the cock bird is deficient in these directions, all his progeny will be affected, and, if he is serving a dozen hens, there may be a loss of nearly 150 pounds in final weights. The above does not mean that there should be any neglect in selection of the females, but that the choice of the male is of manifold greater importance.

When selecting a male turkey, a bird should be chosen that is well developed in breast and body, but without excessive size. He

should have a strong, long frame and limbs, be active in habit, carrying himself in a stately manner and freely disporting his plumage, be ready to resent the presence of strangers, and be quick and strong in voice. In these respects, an inquiry into his parentage is desirable.

A very important point to be observed with respect to turkeys is the great difference in weight between the male and the female. When we compare other classes of poultry, it is found that a female Dorking usually represents 79 per cent of the weight of the male; an Aylesbury Duck, 90 per cent of the weight of the drake; and a Toulouse Goose, 72 per cent of the weight of the gander. The turkey hen, however, is only between 60 and 70 per cent of the weight of the male. This does not mean that she has no influence upon her progeny so far as size is concerned. She should be fully developed in length and depth of body, be active in habit, yet quiet in disposition and amenable to control. No greater mistake could be made than in seeking to upset what appears to be the natural relationship between the size of male and female.

Age of Breeding Stock.—Observations would indicate that when the turkey is living in its wild state, it is vigorous in the extreme. Therefore, whatever loss there has been in this direction as a result of domestication, may be put down to the fact that the birds have not yet fully adapted themselves to the change from one state to the other. Our observations and experience have indicated that the most potent reason for weakness of turkeys is due to the use of immature stock, which is becoming more and more recognised by breeders. It is necessary to remember that a turkey does not attain its maturity until it is nearly three years old, from which fact may be assumed that this is the period when the birds have a capacity for transmission to their progeny of the greatest amount of constitutional vigour. Should they be mated before maturity has been reached, or rather before it is approaching, and this practice is continued throughout successive generations, there is a lessening of the vigour. That is in accordance with practical experience and may be accepted as scientifically correct.

The period of mating, however, should not be unduly delayed, otherwise the functional activity may be checked and fertility lessened. A safe rule is not to use yearlings of either sex as breeders, but to regard that as the period of growth. By this is meant that birds of

either sex should not be mated until they are two years old, and they will continue serviceable for at any rate three to four years. One important point is that it is unnecessary to hatch turkeys very early, which is usually the explanation of breeding from very young stock. The one drawback to the use of older males is that they sometimes tear the hens. This can be prevented by cutting the spurs. The disproportion in size of male and female turkeys already referred to makes it all the more necessary that the hens shall be as old as the males and, if either is the younger, it should not be the hen.

Size of Domestic Turkeys.—It is a very common opinion that the wild-turkey is much larger than any of our domesticated races, but fuller inquiry does not justify such a view, and it would be against all experience with other species.

In this connection there is a very important question for the breeder, namely : What weights should the stock be when mated ?—that is, in relationship to the general standard. To a considerable extent size in our domesticated races is abnormal, and by neglect reduction would take place very speedily. Turkeys are kept entirely for their meat qualities, and, therefore, volume of flesh is of importance. We require bulk of frame, a deep keel, a long sternum, and stout legs, abundantly covered with strong, thick muscles, but we do not want fat which adds to the bulk, and at the same time checks the functional and muscular activities. Therefore, both in the case of cocks and hens, the body should be kept hard and firm, and, so long as the skeleton is large, heavy weights are undesirable, more so in the former than the latter. Hens weighing 16 to 17 pounds, and cocks scaling 20 to 22 pounds, will produce quicker growing and ultimately heavier poults for the market than would fat specimens weighing several pounds more. The capacity to fatten must be there. That is frequently a family quality.

Apart from the use of yearlings for stock, sometimes we find turkey breeders who keep the small, weedy specimens, which can only be sold at reduced prices, for the next season's work. That is a foolish practice, and needs no more to be said in condemnation. Others grow all in the same manner, and pick out in December such as they wish to retain. Selection of those that are intended to be used as breeders eighteen months later should be made in the early autumn before

the fattening or feeding-off stage commences, and given a free run where they can find the greater part of their food until the supply is reduced.

Number of Hens to Males.—It is generally recognised that in turkeys one impregnation fertilises the batch or nest of eggs laid by the hen. Upon that is wanting reliable data with regard to other species of poultry. So far as turkeys are concerned, this is accepted generally. A male turkey can serve a considerable number of hens. Records have been published of a turkey hen laying 80 eggs in a single season. That is very exceptional and, as a general rule, a quarter to a half that number would be the average. A safe assumption is that a dozen to fifteen eggs will be fertilised at each impregnation and that one male turkey should be mated to as many females. In this connection should be remembered that turkey hens are only kept to produce eggs for hatching purposes, and there is more to be lost than gained by increasing unduly the number laid. That this can be effected is unquestionable in the same way as with other poultry, namely, by removal from the nest as eggs are laid. That is undesirable and would probably mean a greater tendency to weakness on the part of the chicks.

Houses and Roosts.—Where there is an abundance of large trees with strong branches, and the position by the undulations of the land can be selected, houses, at any rate in the more temperate climes are unnecessary. An excellent plan, therefore, is to place roosts below trees and to allow the birds to live in the open all the time. Where the position is more exposed and a large roomy shed or barn is available, the roosts may be placed inside so as to afford shelter in unfavourable weather. Most important of all is to secure sufficient ventilation. Where a house has to be built, it is wise to make it of fir bushes, and in this way give the needed protection but at the same time, admitting plenty of fresh air. A house 40 feet by 15 feet and 10 feet to the eaves, will accommodate 40 adult turkeys, that is allow 15 square feet of floor space or 150 cubic feet of air space for each bird. Where such a building can be placed upon dry, well drained ground, no floor is needed. The earth may be covered with chaff in which grain may be fed to be scratched for. In some cases houses are used as a precaution against foxes where these vermin are troublesome.

Hatching.—One of the peculiarities of the turkey, due probably to her more recent domestication, is that she prefers to lay in a nest of

her own choosing. Up to the present time artificial incubation has not been found successful in connection with turkeys, although one of the leading turkey breeders in Suffolk, Mr. Gage Harper, employed an incubator for use in the last two days, simply to bring the young chicks out. He does not recommend the eggs being kept in an incubator during the whole period. Turkeys make splendid sitters and mothers, and, as there is no advantage in too early hatching, the hens usually become broody quite soon enough for our purpose. Where the turkeys are roosting in the trees it is an excellent plan to put two or three boxes or empty barrels upon their sides in some out-of-the-way corner. Very often it will be found that the turkey hen, imagining that she has discovered a place of which no one else knows anything, will commence to lay there. At this period it is necessary to observe her very carefully, and to remove the eggs as they are laid, leaving a dummy in the nest. When she has produced about fifteen eggs some may be left there, and it will be seen that she will commence her sitting operations. If desired, she can be allowed to sit in the same place ; but as many of the best breeders prefer to have the birds under control, when she has become thoroughly settled upon the nest, she may be removed at night elsewhere without much fear of breaking her off. That plan is certainly desirable, because otherwise the male is apt to disturb her and cause mischief to the eggs. Where turkeys are put upon nests of the kind last referred to, these should be in boxes at least 30 inches square, and be there treated in exactly the same manner as described previously for fowls. It is well to mention that sometimes a turkey hen can be induced to lay twenty to thirty eggs. Under these circumstances she may be provided with fifteen, and the remainder placed under a quiet, well-feathered, and good sitting ordinary hen. If that plan is adopted, when the hatching is completed the entire batch may be given to the turkey for rearing, as she is able to brood a much larger number of chicks than she can cover eggs. We must not forget that turkeys are very close sitters, and therefore it is essential to see that they come off the nest every day for feeding. A turkey hen, if allowed, would feed upon the nest, but that is neither good for herself nor for the embryos. If she is carefully handled, and removed to an open yard, and there given food, water and a dust bath, she will return to her nest re-invigorated for another day's duties.

The period of hatching is about twenty-eight days. The advantage of using an incubator for the final stage is that there is no fear of the young chicks being crushed by the mother, as is often the case with such heavy birds.

Reports are published from time to time that artificial hatching of turkeys is being successfully practiced in America. European experience, however, is that this has not proved up to the present time successful. Such may arise as turkey eggs require either a different temperature than do those of hens and ducks, or other reasons that are unknown. The chief risks of adopting artificial methods arise from the fact that there is a temptation to use young hens for breeding and to increase the number of eggs per hen. So far as at present known, both methods are undesirable.

Rearing.—When the young birds are hatched, these should be left in the nest for at least twenty-four hours before they are removed; but it is better that the hen should be well fed at once. Large roomy coops of the ordinary pattern are required for turkeys and, for the first few days, to these should be added wooden-framed runs, about 1 foot deep, and covered with netting, because it is generally admitted that turkey chicks are slow in assuming full activity. These runs will not be required for more than about ten days, except when ordinary fowls are employed. Under such circumstances the hens must be confined for a longer period. At the end of ten days the turkey hens may be given their liberty, as they will not be likely to lead the chicks astray too far, in which direction a turkey is more reliable than a fowl. It is essential, however, that the hen and her brood shall be closed in at night. Coops should be placed where they will be sheltered from unfavourable winds, and be about 30 yards apart, preferably on arable land. These must be moved on to fresh ground every day. In districts where there is plenty of natural shelter that is all which is required in the way of protection. Mr. Gage Harper, who was one of the most successful rearers in East Anglia—a district which is wind-swept during the spring months of the year—follows a plan that can be recommended. He always plants a field in rye-grass, and as soon as the rye is from 24 to 30 inches in height lanes are cut with a mower in various directions through it, generally north-west to south-east. In these lanes the coops are placed, and, as a result, the young turkeys have all the

benefit of fresh ground and of sunshine, and at the same time the wind sweeps completely over them. A further benefit is that the hens will be found to strip the heads of the grass, which the chicks devour greedily. For older birds he frequently has oats planted, and the ears are consumed whilst in a green state in the same manner. The period of cooping is about eight weeks, when the red usually begins to appear on the heads, and by this time the coops are moved gradually towards the perches or trees, when it is found that both the mother and her brood will begin to roost there. Practically, by that time the difficulties of turkey-raising are at an end, for, with the appearance of the red upon the heads, the birds are much hardier than was the case previously. The treatment in summer is comparatively simple, as the birds roost either in the trees or in the house previously described. In some districts where foxes and other enemies abound, it is necessary to take special steps to protect the birds. To this end, if they are kept in the open, the earth around the trees and under the roosts is thickly strewn with gas-lime and asafœtida the pungent odour of which is generally sufficient to keep marauders from the birds without doing any harm to them. The gas-lime, however, must be renewed as frequently as is necessary, otherwise loss will result.

Feeding.—Stock turkeys may be fed in the same manner as prescribed for ordinary fowls, but we must not forget that they obtain a large amount of green-stuff and natural food during their foraging expeditions, and that supplied to them should be subsidiary. It is important in the case of the breeders to keep them in good condition, for which purpose full liberty is essential. The food provided may be any of the ordinary grains, but in addition a few peas or beans are very helpful, as they are low in fat and in carbo-hydrates. It is better to feed whole grain than soft food.

Young turkeys are first fed on hard-boiled egg, chopped fine, with boiled rice and soaked stale bread, or rice simmered in milk. The rice should be mixed when quite soft with sifted oatmeal, Spratt's biscuit meal, or ground oats, until it is crumbly moist. They should be fed five or six times in the day, the first feed to be as soon as posible after daylight, and the last about six o'clock in the evening. When a week or ten days old, gradually change the food, introducing barley-meal or ground oats mixed with middlings, also buck-wheat or wheat

(the latter should be boiled) and—most important of all—plenty of onions chopped fine. Any kind of tender green food is useful, but onions are most valuable. Young clover, or lettuce, or dandelion, or nettles, can all be used with advantage. As soon as the birds have "shot the red" they may be fed upon green oats, wheat, buck-wheat, and barley, varied with boiled wheat dried off with barley-meal. The great requisites for successful turkey-rearing are—(1) a dry, comfortable house and run; and (2) good and proper feeding. On cold or wet days mix a little seasoning in the soft food, and give every day for the first three months, a little chopped meat or meat-meal. Bone-meal or fresh bones should be mixed with the food, and there should be a plentiful supply of grit. It is necessary to move the coop every day, or the ground will become tainted. When the young birds are about a fortnight old, let the hen out of the coop for about an hour a day, which may be gradually extended in time.

A dry summer is most harmful to the turkey raiser, for then the supply of natural food and of green food is very scanty. Under these conditions a fuller diet is essential, chiefly in the direction of a more plentiful supply of green food. Those who have plenty of woodland will find a hot summer less harmful than where the land is more open, as the cool shade of the trees prevents the growth thereon being burnt up to the same extent. It is frequently noted that at Christmas turkeys run smaller in size than if the summer has been cool and moist.

Turkey Poults.—In America a considerable trade during the summer is done in what are called turkey poults, that is, young turkeys killed when about ten weeks old, weighing 4 to 5 pounds, at which age they are very fleshy indeed and fine in flavour. For these there is a considerable demand and many turkey breeders are accustomed to hatch a much larger number than they desire to rear for autumn sale, killing off a proportion at the ages stated when good prices can be obtained. This is a branch of turkey raising which has not been developed in Europe.

Fattening.—Upon arable farms turkeys should be fed upon the stubbles as that means a great reduction of cost for food. Up to this period it will be seen from what has been stated previously that there is no forcing for rapid growth and, therefore, development has been equally favourable whether it is intended to retain the birds for

PLATE CIII

Suffolk Turkeys for Christmas

breeding stock or for fattening. A change now should take place. Such as are selected for fattening must be got into good condition. It is found by putting them on to growing roots and vegetables, they are helped to a very considerable extent. The final stage of feeding for killing takes about eight weeks. During the first three weeks these birds should be fed when liberated in the morning with soft food, consisting of ground oats or barley and wheat meals moistened with milk. When satisfied the birds may be permitted to wander off to the fields until the afternoon when they are supplied with all the food they care to eat. At the end of the period named begins the final stage of the process, whether they are intended for Thanksgiving or for Christmas. The turkeys are placed in a dry, comfortable shed, which must be large enough for the number of birds to be accommodated. In these broad perches are used, not more than 3 feet above the ground. Wherever possible such sheds should have open yards to which the birds are restricted. Food and water are placed in troughs conveniently situated but not near the perches. From this time onwards the turkeys are given all the food they will eat. In the morning this should consist of ground oats, mixed with wheat meal and corn or maize meal, and be moistened with soured skim milk. Wherever possible skim milk should be given to drink instead of water as that considerably improves the flesh. The addition of a little pure fat, about half an ounce per diem to the soft food is helpful in softening the flesh. Cut potatoes can also be added with advantage. The afternoon food should consist of whole barley, oats, and a little corn or maize, which are much more easily digested if steamed or soaked in hot water. When the birds are fully satisfied all food should be removed, and it is necessary to keep the troughs clean by frequent washing. There must be a plentiful supply of coarse grit and sand, and a little slaked lime or old mortar may be added. An excellent plan is to keep a supply of coarsely powdered vegetable charcoal within reach and it is surprising how much the birds will consume. Under this treatment the flesh upon the body will be largely increased in quantity, greatly improved in quality and have that soft velvety feel which is so desirable.

Killing and Dressing.*—The usual method of killing a turkey is to first fasten the legs and wings with soft string, which must be strong enough to bear the weight. By means of that fastening suspend it to

*Plate CIII.

a beam, head downwards, so that the head will fall about midway on the operator's body. Pass the left arm round the turkey, so that its tail will point behind. Take its head in the right hand, with the fingers under the throat, and thumb at the base of the skull; now give a sharp, sudden, strong jerk downwards, and a sharp twist upwards and sideways, and death will be instantaneous though there may be considerable muscular exertion for a time. If it is thought desirable to bleed, that can be secured by cutting the throat; but this must be done at once. Turkeys can also be killed in the same way as fowls, already described.

Plucking is the same as described in the chapter on table poultry, except that the flight feathers are left in the wings. Turkeys are easily plucked and it is only necessary to turn and tie the wings before sending to market.

CHAPTER XXXVI

DISPOSAL OF PRODUCE.

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DISPOSAL OF PRODUCE.

THE EGG TRADE—GRADES OF EGGS—QUALITY TESTS FOR EGGS—SALE OF EGGS—TESTING—GRADING—PACKAGES—TABLE POULTRY.

A well-known writer has said (1) : " Whenever a man who understands business seeks to put upon the market a commodity in which he feels confidence, he first organises the selling end," and " The selling end is by so much more important than the productive end that it is everything." There is no question that lack of organisation on the part of producers of eggs and poultry has prevented their realising more complete success. The complexity of our modern life, with vast aggregations of people unable to produce their own food supplies, has added to the difficulties of the problem, has increased cost to consumers and expenses to producers, although at the same time it has increased demand. Distribution is essentially of the utmost importance. Those engaged in it must be remunerated for their services. The work of the producer is to supply what the market requires and will pay most for, and by ensuring the best quality command the highest returns. In that case they can, almost always, obtain the highest prices which a market affords. Supply and demand are, however, dominant factors in the fixing of prices.

The Egg Trade.—In Chapter XXVIII will be found information as to the production aspect. It is necessary to remember that demand for eggs is variable, largely influenced by prices. There are, however, principles which should be applied, namely :

Eggs are a perishable product

Eggs rapidly deteriorate, varying in accordance with the conditions under which they are kept. Deterioration may be checked or the process enhanced.

The egg contents change in accordance with the time held and the environment.

The natural tendency is for an egg to decrease in value every day after it is laid.

Not every new-laid egg in point of time is of first quality.

Appearance, as in everything else, has considerable money value in eggs, and especially when the internal quality is in correspondence.

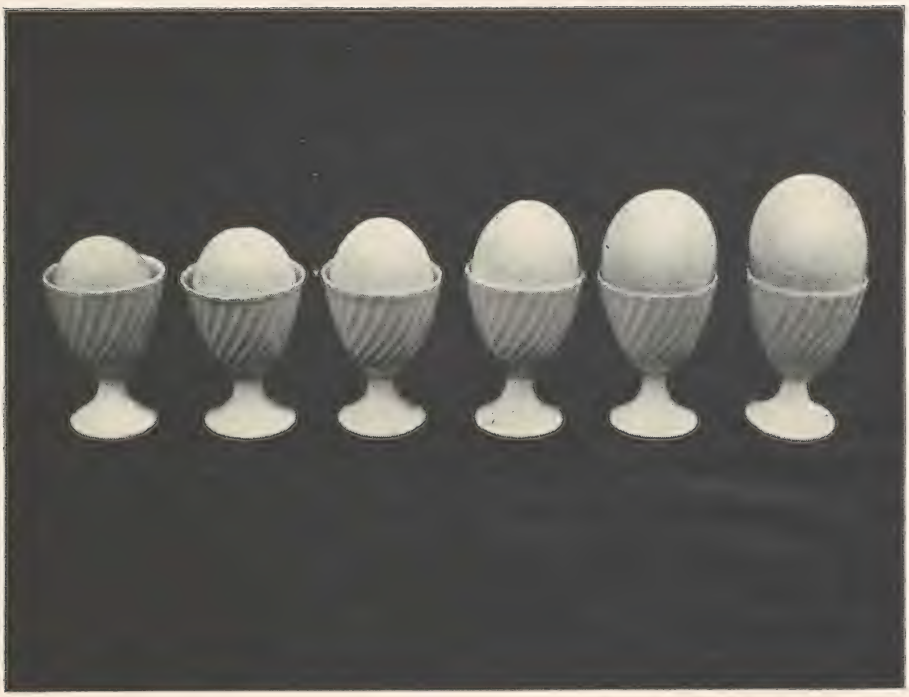
The quality standard is lower in some districts and countries than in others. Where that is the case prices are usually lower. Freshness is largely determined by the period which elapses between the time an egg is laid and when finally sold to the householder, in which distance to travel and methods adopted in marketing have great influence. Producers near to the great centres of population can usually obtain higher prices, where the system adopted is conducive to rapidity of access to consumers. This advantage is often sacrificed by neglect. Apart from preserved eggs, which come into another category, distance is the most important factor, and explains why values decrease as the radius of supply increases. Great improvements have been made within recent years by cool chambers on steamers which have done much to enhance the quality of long distance supplies. At the same time these do not alter what is stated. The local or near-by egg should always command the highest price, and be most nutritious.

Grades of Eggs.—In the retail trade eggs are generally classified as follows :

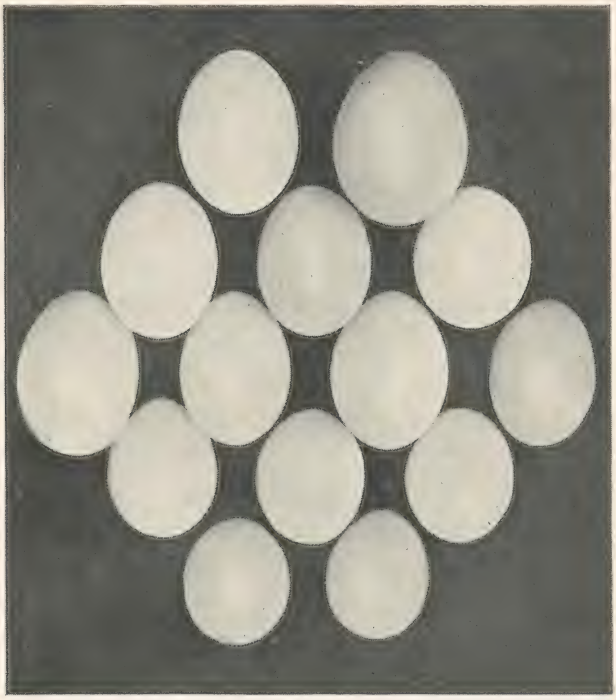
1st Grade	New-laid, 3 to 5 days old.
2nd Grade	Breakfast, 6 to 10 days old.
3rd Grade	Fresh, non-preserved, or brought from distant countries, a month old or more.
4th Grade	Cookers, in autumn generally preserved. At other periods of the year the origin of eggs of this grade is very doubtful.
5th Grade	Nondescript, inclusive of small and preserved eggs.

Size is an important consideration as indicated below. Only No. 1 and 2 are fit for boiling whole, which is the supreme test of quality. No. 2 are largely used for poaching or frying. An egg that would be objectionable if boiled in the shell can be used when broken out, as the

PLATE CIV



SHOWING EGGS 13 *to* 18 LBS. PER 120 IN SAME SIZED EGG CUPS



A MIXED LOT OF EGGS showing different sizes

gases which accumulate in the egg due to increased age escape without flavouring the contents.

Quality Tests for Eggs.—1. Size.—The weight of an egg does not determine its nutritional value, or density of the contents. A very large egg may contain a greater proportion of water than one which is smaller. At the same time size is important, determining the retail price. Consumers demand, and retailers must supply, eggs which weigh at least 2 ounces each, i.e., 15 lb. per 120, or over, and in some markets 16 to 17 lb. eggs have the more ready sale. In the autumn when pullets come first into lay, and those from hens are scarce, the standard is not quite so rigid. The aim should be as far as possible to supply eggs over 2 oz.

2. Shape.—In this respect there are considerable differences. Some eggs are long and narrow, others are almost as broad as they are long, whilst the greater number are between the two. The last-named are preferable. Anything in the direction of malformation or bad shape detracts from the sale value.

3. Evenness and Strength of Shell.—A rough shell is objectionable. During the autumn and winter a rough shell denotes preservation by lime water. The smoother the shell the better. A strong, thick shell may mean that the proportion of edible matter to the total weight is less than when the calcareous covering is smooth. Such, however, is more than compensated by the fact that there is a slower evaporation through the shell if it is thick and close, and the eggs carry more safely.

4. Bloom.—A new-laid has a bright, shiny coating on the shell, called the "bloom." Experienced buyers can tell the age more or less by its appearance. A dirty-shelled egg is useless for the best trade.

5. Colour of Shell.—As explained above there is demand in some markets for tinted or brown-shelled eggs. It is thought in the months of scarcity that these are more likely to be new-laid. With enhancement of fecundity that idea is now no longer justified.

What is the nature of the contents of an egg determines the value. The buyer may be misled by appearances. The final judgment depends upon the contents. Testing by light reveals what is the internal condition.

6. "New-Laidness."—An egg is in the best condition and highest in nutriment and flavour within a few hours after it is voided by the hen. An egg boiled when, say, two days old, shows that the white does not inspissate to the extent that it will later, remaining milky, clothy, and flaky. The unknown elements which induce that condition disappear in three to five days, which betokens the age. Something has disappeared which influences flavour and quality. Such eggs are no longer of the first grade.

7. Fullness.—One sign of new-laidness is that the egg is full, by which is meant that the air-space is scarcely visible, although if immersed in liquid preservative when quite fresh the same applies. In an experiment made under normal conditions, that is, kept exposed, out of 120 eggs, weight equal to one egg was lost in 6 days, 2 egg contents in 13 days, 3 in 21 days, 4 in 29 days, 5 in 36 days, 6 in 47 days, and 7 in 60 days. Thus the actual loss of weight by shrinkage was nearly 6 per cent in two months. The test was made in cool weather. During the hot months, or if kept in a warm place, the loss would have been much greater. Candled eggs revealing large egg space are depreciated in value.

8. Brightness.—A perfectly new-laid egg should show through the shell a clear opaqueness, without spots, or dark areas.

9. The White and Yolk Ligaments (chalazae) must be strong and firm, and the yolk be round. A flat yolk indicates age. These cannot be revealed until the shell is broken.

10. Colour of Yolk.—The finest egg has a reddish-yellow yolk, not pure yellow, which can only be distinguished when the shell is broken. Pale yolks are objectionable. These are due to lack of green food, and are deficient in nutritive value.

11. Infertile Eggs keep better than those which have been impregnated, as explained in Chapter XXVIII. In this connection it is noteworthy that the value of an egg is fixed, not at the point of production, nor in the local collecting centre, but by its condition when delivered to the consumer.

Weight for weight an egg contains more nutriment than almost any other class of food. There is no bone or fibre or gristle, and the proportion of water is not greater than in meat. Recent discoveries have revealed the fact that the yolk of eggs contains those elements which

have defied the investigations of chemists known as vitamins, and which are essential factors for growth. Eggs enter into a multitude of dishes, adding to their palatability and digestibility and nutribility. A cook without eggs would be helpless in many directions. Eggs have been proved to be most potent in prevention of what are known as deficiency diseases, and in this respect of the utmost value. They form one of the most important of natural foods, as indicated by medical and scientific observation and research, and by practice in households all over the world.

Sale of Eggs.—The methods of disposal adopted are as under:

Direct Sale to Consumer.—Where producers and consumers are within easy reach of each other this system yields the greatest returns to the former, and the finest quality to the latter.

Sale by Producers to Retailers.—In the great centres of population direct sale is possible to a limited extent, and, in many cases, would be costly and troublesome in distribution, as the requirements of each household are relatively small. Under these conditions the service of the retailer is essential, as he distributes with other goods and thus reduces the costs. It is, generally speaking, of the greatest value to larger producers, who can guarantee quality.

Local Collection.—Where the markets are distant, and the volume of produce is individually small, it must be bulked to reduce costs of transit and regularise the supplies. Therefore, an intermediary must be found between producer and the distributing trade. Everything depends upon the effectiveness of the organisation. In some instances the system works satisfactorily. In many others it does not. The great hindrance to progress is that, generally speaking, all-round prices are paid, and that there is not adequate remuneration for higher quality.

In countries and districts where there is a high rate of production and these are distant from consuming areas, organisation on a wide scale, either by private traders or co-operative societies, is necessary. These are usually in touch with the wholesale markets to which supplies are forwarded in bulk.

Auction Sales.—The system of selling eggs by auction in the production areas is increasing. Everything depends upon how far these are attended by buyers. The usual custom is for producers to

send to these, and for the individual lots to be offered for sale. The most perfect organisation on these lines has been reached in the Netherlands, usually on a co-operative basis. Eggs are sold as from the place of origin, so that reputation is an asset. This is described fully in the Author's "Report on the Poultry Industry in the Netherlands."(2).

Wholesale Markets.—In all the great consuming countries and centres of population eggs pass mainly through the wholesale markets, in some of which the operations are very extensive. The supplies are drawn either from other countries or the more distant districts of the same country. As a general rule the quality of these are not of the highest grades. They, however, are essential in that the distribution of what may be termed surplus supplies is organised.

Co-operation.—In Denmark the egg trade has been largely built upon a co-operative basis. The same system has attained success elsewhere, chiefly, however, where the local or district consumption is unable to consume the supplies. Under such conditions, with effective management, by control of collection and distribution remaining in the hands of producers thus combined, the standards of quality and the prices obtained are enhanced, due to responsibility being thrown upon those who are most immediately concerned. As a competitive factor co-operation has proved of the greatest value, and it has done much for improvement of methods by compelling traders to improve their practice.

Testing.—Not every egg is of first class quality. Where the supplies have to pass through one or more intermediaries are other factors which may be due to deterioration by holding or subjecting the eggs to bad conditions. The object is not merely to discern bad and stale eggs, but to discriminate between the best and the better, the better from the good, and the good from the inferior, as each have their individual values.

For effective testing a dark room is required. The method is by passing light through the eggs so that its internal condition is revealed. A powerful lamp, gas jet, or electric bulb, is encased in a black metal cone or box, on the sides of which are one or more oval apertures, slightly less in size than an egg. When the last-named is revolved by hand against the opening, the size of air-space and internal condition can be seen. This test is the most reliable.

In Denmark and elsewhere strong electric lights are enclosed in a well, the sides of which consist of bright reflectors. On the top fits a tray with perforated bottom so that no light can pass except through the eggs. That is much more rapid than individual testing, but is not so effective.

In Holland an apparatus is used consisting of a revolving table on which are several openings, into which fit trays holding fifty eggs in each. One-fourth the table is at a time in a dark cupboard for testing, by means of well-lights as already mentioned. Attendants outside place the trays in position, removing after testing, each lot being passed into the cupboard by revolving the table.

Grading.*—This process has two objects in view, first, discrimination as to quality of contents, and, second, size, both of which are important as indicated above. With regard to the last-named may be mentioned that evenness of size adds to the appearance. A large egg dwarfs all others in the case, making these look smaller than is the fact; whilst a small egg detracts from the value of the bulk.

Grading, however, facilitates safety in transit. Where eggs are shipped in large cases and packed in straw or wood wool, or both, the eggs must be closely graded so that each one may be of the same size. Otherwise, as no fillers are used, and the eggs touch each other, breakages would follow. It is necessary that each egg shall be firmly held by the layer of packing material above and below.

Packages.—What is of the utmost importance is that the packing shall be clean and sweet. Eggs are very susceptible to external influences. If they are packed in dirty or musty material, or anything which is odorous, they will be affected thereby. Inattention to this question, or the packing of dirty eggs, due to lack of clean nests, reduce their value.

Packages vary considerably, from the large 1,440 cases generally used on the Continent of Europe, to cartons, the last-named of which containing a dozen which, whether packed by and bearing the name of the producer, which is desirable wherever possible, or by the merchant, has many advantages, and a convenience to the purchasers, provided that they are disposed of quickly. If held the advantage would be sacrificed. The boxes which have come more and more into use are those holding thirty dozen eggs, fitted with cardboard or other fillers

*Plate CIV.

so that each egg is in its own separate section. Where eggs are sent short distances, and especially if forwarded direct to large consumers or retailers, returnable cases are largely used, and are satisfactory if kept clean and the fittings renewed whenever necessary. The wise course to adopt is to conform to the general practice of any country.

Wherever possible, that is, if the costs are not too great, new non-returnable cases should be used. Attention to the dangers of packing in old cases is stated officially (3) as follows : ' Considerable quantities of second-hand imported 30-dozen cases have been brought into use in recent years. Many of them are very light in weight and totally unsuited for repeated use. They were constructed for single journeys only and require continual repair if used again and again. The lids, in particular, become unsound with constant nailing. Many of these cases are sent out by egg merchants, who also handle imported eggs, for the purpose of collecting their supplies of home produce. They are also bought by both producers and dealers from merchants in the wholesale markets and from retailers. In many instances they have been found unsatisfactory and their use has declined to a certain extent. But they are still largely used for the transport of eggs by rail and, to a greater extent, by dealers and producers for carrying eggs to and from markets by road.' Much loss of quality in eggs arises from use of old cases.

Table Poultry.—The trade in poultry for consumption varies considerably in all the great markets, due to the different classes of customers. Much higher prices can be obtained in some districts than in others. Under these conditions supplies must be graded in accordance with the requirements of retailers whose business is to prepare the birds to meet the wishes of their customers. The direct trade between producers and householders is small except in the areas where the birds are raised. With eggs, as stated above, the object is to come into direct contact with consumers and retailers without any intermediaries, so as to avoid unnecessary handling and profits, and to insure rapidity of transit. In respect to poultry, with a few exceptions, it is more profitable to sell through the recognised markets or wholesalers, for the reason that those concerned can grade the birds in accordance with the demands of poulterers. In that way higher returns are obtained than if dispatched directly to retailers.

Except in the fattening districts, where collection is well organised, and the countryside is scoured by higglers buying birds, traders do not usually obtain a regular supply. A buyer may find in the local market a plentiful supply one week and the next very few. Hence the business is largely speculative. The producer suffers most of all by irregularity.

Where there is a large Hebrew population there is at certain seasons of the year a large demand for larger fowls, and high prices are paid for meaty specimens, even adult males and females. These birds are purchased alive, for the Jewish law requires inspection by officials before the birds are killed, and that is carried out by appointed butchers. Usually buyers attend the local centres to purchase these birds.

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(2) Report on the Poultry Industry in the Netherlands, by Edward Brown, F.L.S. (London, 1921).
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CHAPTER XXXVII

THE BUSINESS ASPECT OF POULTRY HUSBANDRY.

CHAPTER XXXVII

THE BUSINESS ASPECT OF POULTRY HUSBANDRY.

CAPITAL—STANDARD OF LIFE—ESTABLISHMENT CHARGES—PROFITS—CULLING—LEAKAGES—ACCOUNTS.

It is not our purpose to consider in this place the differences between what may be termed surplus-producing and consuming countries and districts, though these are of considerable importance to those engaged in Poultry Husbandry under the former conditions. Nor as to the large international trade which has grown up in eggs and poultry within comparatively recent years. It is enough to record the complete change which has taken place. The "pin-money" notion in respect to farmers' wives and daughters, and that "poultry don't pay" as a general axiom, have been abandoned. There is abundant proof that poultry, if properly managed, are one of, if not the most profitable of domestic live stock kept upon farms. Further, that, apart from breeding farms, fattening plants, &c., which had for generations been successful, egg and chicken farming on specialist lines, as described in previous chapters, is capable of yielding returns which are worth the enterprise of those who possess the necessary skill and determination. It is not, however, a task for the indolent or the incompetent. An opportunity is afforded for able men and women with all the pleasure and health of an open air life. There are, however, several questions which are commended to the attention of all concerned.

Capital.—Under ordinary farm conditions the amount of capital required for equipment is comparatively small. For flocks maintained about the homestead it is practically *nil.* Any purchases of stock or appliances are made out of income. Where there is development, whether the extensive or semi-intensive system be adopted, there must be expenditure for stock, houses and appliances, although

relatively this need not be great, more especially if the enterprise is developed gradually. Under these conditions it is scarcely possible to estimate the amount of capital required. The most important point is to restrict it to whatever will prove a profitable investment yielding a return by increase of production or economy of basal charges.

The question assumes a totally different phase where operations are primarily limited to the poultry, and cultivation is contributory. Under these conditions, whether the plant be a breeding, an egg, or a chicken farm, a considerable amount of capital is required. In this connection, however, is an interesting fact, namely, that some of the most successful poultry farmers have built up their plants gradually and started with a very small capital, which indicates that the profits are substantial. These were content during the formative period to work hard and live modestly. Others have succeeded who began on more extensive lines having capital available enabling them to do so. Why so many promising enterprises have failed is that, whilst the capital was enough to establish and equip the plant and purchase the stock, there was not sufficient margin to provide means of living during the first two years—that is, until profits could be realised. To create such a plant on a profitable scale the process must be gradual and cannot be hurried. Capital and experience must go hand in hand. A rough computation is that, with a one-man plant where many houses and appliances can be built by the owner, £50 (250 dollars), will be required per hundred fowls kept, and where it is a breeding plant, or run by employed labour, the average will be double that amount.

The Standard of Life.—Where there is an assured income from other sources, and the poultry are supplemental, this consideration does not arise. Those whose requirements are modest and contented with a simple life, doing all the work, and having no false pride in the selling of produce, can find in Poultry Husbandry an opportunity for gaining a satisfactory living, provided they are able to secure a market and paying returns. It is from this class that not a few of the most prominent poultry farmers have arisen. A new field of endeavour has thus been opened. There are many who are seeking for superior conditions to those named. They require a good house to live in with modern comforts and the surrounding amenities, possibly a motor car. In their case expenditure for equipment and for management must be

greater, and the operations on a much larger scale. The former are compelled to exercise repression, and remember what John Ruskin said, namely, that the true benefit is to extinguish a want—in living with as few wants as possible. This is not a farmer's question, but is essentially that of the specialised producer.

Establishment Charges.—Before profits are realisable by the poultry farmer, what are known as establishment, or over-head, charges have to be provided for, that is, the expenditure for rent, renewals of plant, replacement of stock, interest on capital, and incidentals. The margin between these and the returns received for sale of produce constitutes the reward for labour, or profits. Such charges vary considerably in accordance with the conditions. In all cases it is important to carefully watch these outgoings. The rent of dwelling, or of household expenses should not be charged against the poultry farm, even though these be wholly maintained by it. They are personal charges. What is here stated applies to all types of poultry farms. On breeding plants the establishment charges are higher than on production farms, and are compensated by greater returns. Many of the reports published as to poultry farming are misleading, in that only the costs of feeding are stated and the establishment charges are not included. Generally speaking it is found that of the total costs of production food on poultry farms represents two-thirds, and establishment charges one-third.

Profits.—There are two important factors which have contributed to the development of Commercial Poultry Husbandry within the present century, namely, first, enhancement of average production of eggs as a result of selective breeding, and more effective methods of housing and feeding; and, second, increases of prices following upon organisation of marketing, greater consumption, the rise in standards of living, together with the more rapid increase of demand as compared with supply. With respect to the former, although it may be true that exceptional layers have always been known, and that methods of management have been in the direction of higher fecundity, there is little doubt that the undoubted advance in average production of eggs has mainly been by the elimination of the drones, and by getting rid of the hens when these cease to be profitable. Reference to the last-named will be found below.

From such evidence as is available may be assumed that where the right class of stock is chosen, and the methods adopted of breeding, management and feeding are conducive to health, vigour and productiveness of the stock, an average net profit can be obtained, after payment for food and all establishment charges as stated above, of 7s. 6d. to 10s. ($1.80 to $2½) per head per annum, that is, without labour. On such basis the profits per hundred hens would be £37 10s. to £50 ($187½ to $250) per annum. These returns indicate the number of fowls to be maintained in order to provide the living profit which is desired. One important fact, however, is that there is a tendency towards the lower scale as the number of fowls is increased, even though there may be more economical purchase of food and other supplies, and higher returns in sale of produce, due to the necessity for employing labour, and that the rigidity of management and of feeding is somewhat relaxed. The main reason why egg farming is more profitable in proximity to residential and industrial areas is that the expenses attendant upon marketing are less than in the more remote areas, and that the returns are consequently higher.

One explanation why there has not been the same development of table poultry production on commercial lines, and that the great majority of these birds are raised by small occupiers or general farmers, is that the operations must be on an extensive scale to give an adequate return. Except for very early birds, and for those of special quality where there is exceptional demand at hand, a net profit of 1s. to 2s. (25 to 50 cents) per bird is the maximum. That means a thousand chickens or ducklings must be raised to yield an income of £50 to £100 ($250 to $500).

Culling.—In all breeding there is a necessity for systematically and regularly getting rid of those birds which have served their purpose, and are no longer in profit, except these appear to possess values that indicate high qualities as breeding stock warranting their retention. Such fact has long been recognised among the more progressive breeders. Many farmers have been slow to realise the importance of eliminating the non-productive hens in the flock by retention when they become a charge upon, instead of a source of, revenue. With specialist egg farmers the tendency has been to go to the opposite extreme, as a result of which hens are often disposed of long prior to

the time when they have ceased to be profitable, thus increasing the costs of replacements. The fact that pullets and hens may have ceased to lay in, say, May or June, may be due to a craving for a period of rest especially when these have been highly productive during the autumn and winter months. In a large number of cases these are found, if retained, to rapidly pass through the moult and come into profit again during the summer, and yielding a good supply of eggs at a season of the year when prices are attaining their maximum. The tendency which is all too evident, of mechanising the management of poultry should be resisted as it does not lead to the ultimate profit which is often assumed.

Culling should be a continuous process, and not merely intermittent. Pullets commencing to lay when six to seven months old frequently are unable to stand the strain, and do not make any increase in weight of body. They are anæmic, have small combs and wattles, which are dull instead of having the bright appearance denoting health and productivity. They have snaky heads and eyes, and sometimes are inactive. These should be got rid of, no matter what is the time of year, and also any showing signs of disease. Further, hens which do not lay during what is normally the productive season, except such as become broody, may be eliminated, as they are unlikely to pay for their keep. An interesting and valuable feature is that, in addition to the signs indicated above, the relative depth of body in the pelvic region is an indication of capacity for egg-production. Those hens which are narrow and shallow behind can safely be culled out. A further help in discernment as to whether a hen is laying is, in the yellow-legged and fleshed breeds, the depth of pigment on legs, skin and beak. With these there is a loss of colour during the time of high production, assumed to be drawn upon to supply the yolks. When there is a cessation of egg laying the colour returns in the directions stated. Hence bright-coloured legs and beak, which can easily be seen, reveal the fact in the spring and summer that the bird is not laying. As the way of profit is not by the exceptional productivity of a few birds but the average of the entire flock, culling on the lines suggested, in combination with sane selective breeding, is invaluable by getting rid of the birds which are not and never will be profitable. General farmers have found this system changing loss into profit, and

in some instances have increased the number of eggs whilst getting rid of fifty to seventy-five per cent of their hens.

Leakages.—Many important businesses have been successfully founded on the utilisation of subsidiary or waste products. There are those who imagine that success is to be achieved by the amount of money expended. Capital in one form or another, for that is not always merely expressed in money, is necessary. That it can be wasted is evident. Expensive houses, appliances, and foods, reduce instead of increase success, and enhance the costs of production without that of returns. Some of the most successful poultrymen have built up their business on a very small initial capital, securing their living at first in other ways and gradually extending. Where the majority of those who fail err, is not in the direction of large expenditure, but by neglect in detail and what appear to be small economies. Such leakages may be small in themselves, yet large in the aggregate. Waste brings no return, and all the time represents loss. Unnecessary capital burdens the enterprise. Wise expenditure upon what will help to attain success is true economy. Below are indicated some of the directions in which special care is necessary :

Good houses are a wise investment, as these last if cared for. Cheap, flimsy houses, are always dear.

Much loss arises from neglect to keep houses and appliances in good repair. 'A stitch in time saves nine.' Five minutes labour at the right time, which is at once, often prevents heavy loss.

Such birds as have served their purpose, whether male or female, should be fed-off and killed when market prices are good, even if, in the case of hens, a few eggs are sacrificed. Special reference is made to this in Chapter XXVIII.

In some districts were it not for keepers of poultry wild birds and rats would have a lean time. These multiply by reason of the food intended for poultry.

Studying the grain and meal markets is essential to success. Buying well, in sufficient quantities, and at the right time, reduces the cost, as does feeding judiciously even though liberally, seeing, however, that all is consumed.

There is much wastage by neglect of appliances. After the hatching and rearing season incubators, brooders, and coops should be

emptied, dried, fumigated, repaired, where necessary, and stored in dry places.

Feathers and Manure should be treated so that they will be saleable. The sooner the former are turned into money the better.

Labour.—The question of employment of labour does not concern the great majority of keepers of poultry, for the reason that whatever is required is the work of themselves or their families. Proper appliances minimise labour, and are economical. When those who take up this business are unable to operate the enterprise, and have to employ labour, the question is important, as it is expensive. The need is to see that it is remunerative. Hence the knowledge and skill of the owner will often determine the efficiency of the workers. Labour must be fully and profitably employed, or it becomes a heavy charge and may be responsible for failure. In some of the most successful poultry farms the system has been adopted of the workers sharing in the profits. That makes for efficiency, as those engaged realise their responsibility for success.

Accounts.—Without systematic accounts it is impossible to know the position of any business or pursuit. Time and labour expended in this manner is economic. Not only do these record whether there has been profit or loss, and the amount in either direction, but indicate leakages, and lead to economies. There are many forms of Account Books sold. Simplicity combined with efficiency should be aimed for. In smaller operations a cash ruled book may be used of an ordinary form. The main factor is to make the records daily, leaving nothing to memory. Accounts afford no opportunity for imagination. They should reveal facts, whether these be favourable or otherwise. There must be no self-deception.

The system may thus be explained: At the commencement of the financial year, which need not be January 1st, although that has the advantage of being when the stock is at the minimum, birds, houses, appliances and stores should be valued and recorded. Such valuation should be fair, neither excessive nor cut down unduly. In this respect the most difficult part of valuation is with regard to the stock. The higher the valuation at the beginning of the year, the less the profit, if any, will be. During the year all items of receipt and expenditure, even those which appear to be trivial, should be recorded in their

proper places regularly and methodically. The number of eggs laid should be entered daily, and if there are different breeds and flocks, how many from each, so that the averages may be worked out. A hatching record is indispensable, again with indication of results from the various breeding pens showing fertility and hatchability. On the receipts side will be put down eggs sold, how many are incubated or consumed in the household, and also with respect to chickens and stock disposed of. On that of expenditure every item requires to be entered, namely, purchases of stock or eggs for hatching, additions to houses and appliances, renewals and repairs, food, labour, rent, and incidentals, of which there will be many individually small yet considerable in the aggregate. At the year end again a valuation is made. This must be exhaustive and rigid, showing number and value of birds, houses and appliances, stores, &c. The valuation of stock should be on the basis of what they have cost in the cases of such as have been bred and raised on the farm, and for others what these would realise if sold at the time, not a possible value at a later period. It is easy for the poultry farmer to mislead himself by a valuation that does not afterwards justify itself.

The debit side of the Balance Sheet will show the valuation at commencement of the year, all the items of expenditure in their totals should be entered on it, and in addition interest on capital, and depreciation on houses, appliances and equipment at 10 to 15 per cent. On the credit side will be placed receipts from all sources, inclusive of sales and values of whatever eggs or poultry have been consumed in the household. The final valuation is added. When each side is totalled the balance will indicate profit or loss on the year's operations. If the total on the credit side is the greater the balance will represent the amount of profit; if on the debit side the balance will be the loss incurred on the year.

CHAPTER XXXVIII

DISEASES OF POULTRY.

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INCREASE OF DISEASE—SCIENTIFIC RESEARCH—PREVENTION THE MAIN OBJECT—HEREDITARY INFLUENCES—CONDITIONAL CAUSES—LESSENED FUNCTIONAL ACTIVITY—INFLUENCE OF FOOD—BACILLARY WHITE DIARRHŒA—COCCIDIOSIS—HEALTHY STOCK—USE OF SERUMS—SYMPTOMS OF DISEASE—POST MORTEM EXAMINATIONS—PARASITES — SIMPLE AFFECTIONS — VARIOUS SUGGESTIONS — MOULTING.

In no department of human knowledge has greater progress been made within the last two generations than in medical and veterinary science. At the same time it is evident that there is an appreciable increase of disease. Many forms, both in human beings and animals, are now met with that at one time were unknown. Undoubtedly in not a few instances, what is here stated can be attributed to more complete definition and to the discoveries made in respect to bacterial and other inciting influences. It would seem to be true that as a result of greater aggregation of human beings and animals massed together in communities, where the conditions of life are more intensive, there is a tendency to development of disease which did not exist under former conditions. What is here stated is certainly the case with poultry. In former times disease was known and in some instances assumed a very serious form. These, however, were comparatively few and isolated. It was not until the numbers kept upon a given place were largely increased and that, as a result, the balance between animal and plant life, which is part of nature's plan, was upset, that losses by disease became a very important factor. Moreover, the methods which are now generally adopted not only tend to a diminution of natural vigour in poultry and, therefore, reduce the power of resistance to bacterial and parasitic enemies, but that the conditions

are conducive to enormous development and power of these minute creatures which prey upon the poultry, both internally and externally. It may be possible in process of time, with greater knowledge and wider experience, to obviate many of the losses which take place, and to maintain constitutional vigour to such a degree that fowls shall be immune to attacks of bacteria and parasites. The day of that, however, has not yet arrived.

Scientific Research.—One of the most satisfactory developments within recent years is the amount of attention which is being given by trained scientists to study of poultry disease. During the early days of poultry husbandry empirical methods were unavoidable. Poultrymen had to do the best they could. As a result it was often thought cheapest and wisest to kill a fowl that was seen to be sick. Those engaged in this work knew little or nothing as to the cause of disease and how it might be prevented. With development of poultry husbandry on more extensive lines, and where infected flocks were liable to communicate a disease over wide areas, the importance of the question was realised. It became not merely a question of individuals, but the prosperity of considerable areas was affected. The attention of government departments was, therefore, called to this question. The first decided step taken was when the French Minister of Agriculture instructed the late Professor Louis Pasteur to undertake an investigation into an outbreak of what is called chicken cholera which was then devastating the farms of that country. At the present time there are many highly trained scientists in Europe, Asia and America who are devoting themselves to study of poultry diseases. Whilst it cannot be stated that the advance made has been nearly so great as the need, that is due to complexity of the problem. It may be hoped that more and more will be done in this way for the reason that disease is the great menace of poultry husbandry at the present time.

It is necessary to keep in view that there are two aspects of the question; first, diseases which are individual, that is, isolated instances, either single birds or limited groups. Although with these the loss is comparatively small, it is probably more wide-reaching than generally supposed. Such instances may be taken as revealing loss of vigour and the possibility that other members of the flock but which are not affected may be carriers of the disease to their progeny; second,

must be considered those forms of disease which become epidemic, causing great loss and, in many cases, infecting considerable areas. We have seen several such epidemics in Europe and America, the results of which were disastrous in the extreme. No attempt is made at this time to deal exhaustively with the problems to which research is being applied for the reason that this, to a large extent, is in the experimental stage. Doubtless we are on the verge of important discoveries which may alter entirely our conception of the question. The poultry keeper must be a student of literature published on this subject, and be guided by such increase of knowledge as is available. Unfortunately many scientists are prone to use language of a highly technical character and which is not understood by the rank and file. It has been well said that " Terms must be defined in terms which do not in turn require definition."

Prevention the Main Object.—Whilst the scientist must be looked to in order to discern the nature of disease and, as far as possible, how this is caused, the great object of the poultry keeper is prevention. Success in that direction will be by adoption of methods which make for the vigour and, therefore, to a large extent, the immunity of poultry. The small comparative value of each unit means that, apart from the danger of infecting others, such value may speedily be expended by a course of treatment. And, further, that there is no assurance of such birds being completely cleared of injurious bacteria where these are the cause. There are many instances where it was thought the system adopted was hygienic and protective. In spite of all being done that appeared possible, disease broke out and great loss followed. It is probable that the explanation was that the method of breeding had so reduced the vitality or power of resistance, that the birds were unable to combat their minute enemies to the same extent as had been the case previously. This aspect of the subject is one which must be kept constantly in mind. Disease, whether individual or attacking a large number of poultry, should be regarded as a warning that methods adopted are in some directions conducive to its development. A perfectly healthy bird would not become infected even if exposed.

What, therefore, must be diligently sought for are the contributory conditions, whether involved in breeding, methods of treatment, environment, feeding, etc., in order that prevention may be effective.

Practice and science must act in unison. The knowledge of advanced practitioners who have studied hygiene and sanitation, and that of investigators whose interests are in purely scientific research, are equally necessary. Too often, reports published as to outbreaks of disease are incomplete in that they stop at the point with which poultry keepers are most concerned, namely, prevention. The following paragraphs indicate some of the contributory causes.

Hereditary Influences.—Within recent years, as a result of research, it has been proved that germs of diseases may be contained in eggs laid by infected hens and thus transmit to the chickens which may be hatched from these. There are, however, some diseases which do not appear to be transmissible in this way. For example, chickens hatched from eggs laid by hens which are suffering from tuberculosis in one or other of its forms, even where the lungs or the liver are affected, do not immediately show signs that the parental disease is inherited, and sometimes may escape altogether. At the same time, it is within general knowledge that such progeny are specially prone to suffer from the same disease later in life. The concensus of medical opinion is that whilst the disease named is not directly inherited, there is a lessening power of resistance to attacks of bacteria. As a consequence of these and other observations it cannot be too highly emphasised that only sound stock should be used for breeding. By this is not meant that if an otherwise valuable bird has a bad cold or some other slight affection, it should be discarded, as these are local and temporary and would cure themselves if left alone. No fowl, however, respecting which there is the slightest indication of a serious disease should ever be used for breeding or kept with other stock. Acute diseases are much more rapid in their effects and are less dangerous, for the reason that these usually end in death or leave the birds so debilitated as to be useless. This question is so serious that no risks should be run. It is questionable whether absolute immunity to disease can be found. At the same time much can be done by exercise of great care, and above all never to use forced stock for reproductive purposes. It will be by these methods and application of favourable conditions that hereditary influences can be checked.

Conditional Causes.—Probably the greater number of affections and diseases, chronic and active, are due to bad environment, even

though some of these may apparently arise from other influences. It is impossible to limit the effects of non-hygienic or insanitary conditions, which may develop in many different ways. As these have been dealt with in previous chapters, it is unnecessary to do more than re-emphasise the essential importance of the question here raised, namely, that :

Want of proper and efficient ventilation deprives the bird for several hours daily of oxygen sufficient for its needs, and, by compelling it to breathe air charged with carbonic acid gas, impoverishes the blood, overtaxes the lungs, and, if continued, so weakens the whole system as to render it unable to withstand attacks of diseases, whether chemical or parasitic.

Want of light in the house affords the conditions most favourable to increase of bacteria and parasites, which, by preying upon the fowls, gradually reduce their power of resistance. Sunlight is the most powerful germicide known.

Lack of cleanliness has the same effect as that stated above, in addition to which, however, is the action upon the body through the atmosphere, more especially by ammonia from manure.

Dampness, either in the house or the soil, appears to reduce the vitality by more rapid elimination of heat, leading to chills, and often causing inflammation in certain organs.

Probably that which has been responsible for the greatest amount of disease is tainted soil. Not only does it act like slow poison upon the system, but also the manure offers a medium in which injurious parasites develop rapidly.

When all these various conditional influences are found in combination, as is frequently the case—for negligence is seldom in one direction—we have, on the one hand, reduction of power to combat antagonistic influences, and a great increase of the enemies and influences to be combatted. Under such circumstances everything is favourable to development of disease.

Lessened Functional Activity.—It is a remarkable tribute to the adaptability of poultry that there is so small an amount of loss of functional activity as a result of domestication. Under natural conditions, fowls have to seek for all the food they require and, as a result, the organs and muscles of the body are constantly exercised.

When brought into the service of man, and especially under more intensive methods adopted, all this is changed. Food is supplied almost equally to their needs and, in many cases, the birds are kept within enclosures so that they have not the opportunity of foraging for food even if they desire to do this. Under these circumstances, the danger of reducing the physical powers by absolute disuse is a very positive one. So far as young creatures are concerned, these will take exercise for the very pleasure of it, and which is highly beneficial. When reared in masses, however, their opportunities in the direction named are very limited, and, in any case, it is not continued after maturity is reached to any great extent. In this respect there is a great difference in breeds, some of which are much more active than are others. Under our modern conditions, the tendency to provide food in super abundance, and to limit the activities of the birds, is undoubtedly responsible for a great deal of the disease which is met with. By reduction of exercise, in combination with an abundant supply of food, functional activity is often checked. For reasons which have not yet been made known, the influence of lack of exercise and of reduced functional activity, is not so much seen in respect to fertility of eggs as in hatchability of those eggs and liveability of any chickens that may be produced from them.

Influence of Food.—Food not only needs to be sufficient in quantity, but also of the right quality. Should the latter not be the case, then the former becomes a positive danger. The tendency is to adopt non-natural, and in some cases synthetic, foods which latter are seldom satisfactory. A famous surgeon once informed the author that 95 per cent of his patients would never had need to consult him if they had taken greater care in their diet. In poultry a vast amount of disease affecting the blood and digestive organs is due to the use of unsuitable and rich foods, generally supplied in too great a quantity. Not only so, but these foods usually promote the multiplication of bacteria, as they provide the nutrition upon which these creatures live. There is no need to go into further detail with respect to food as the chapter on that subject can be studied. Mention is here made to indicate that disease may be caused by unsuitable food.

Bacillary White Diarrhœa.—Selective breeding for high fecundity, artificial hatching and rearing, and intensive conditions, have been

accompanied by a great increase of embryonic and post-hatching mortality. This is a serious menace to Poultry Husbandry on specialist lines. In Europe and America the annual losses are enormous in the aggregate. Many millions of chickens fall victims each year to what is termed Bacillary White Diarrhœa, a highly infectious disease, caused by an organism named *bacterium pullorum*, which is believed to develop in the ovaries of hens. These birds may indicate no signs of being infected. The eggs, however, when laid frequently contain the organism. Should a chick be hatched carrying the *bacterium pullorum* its droppings can transmit the disease to others. Mortality is usually highest during the first week. It is not, however, limited to that period, but may manifest itself up to four weeks after hatching. The symptoms are, severe diarrhœa, the discharge being white and often granular, hard breathing, drooping wings, sleepiness, and general lassitude, with a chirp indicative of pain. From the fact that formerly chicks suffered from similar symptoms, though not in any great numbers, it would appear that the organism was in some instances present, but that the majority of chicks were capable of resisting the action of the bacteria. Should that have been true, it is evident that the great increase of this disastrous disease can alone be checked by contributory causes, namely, methods of breeding and management more conformable with nature. It is suggestive that many of those breeders who hatch and rear by hens, or in small units, have not experienced the mortality from which other poultry farmers who adopt mass methods have suffered so heavily. Such loss should be accepted as an indication that the method or conditions are at fault.

Up to the time of writing no cure or applied preventative has been discovered. Hens may be what are termed "carriers" of the infection without any external indication, and appear to be healthy, vigorous and productive. With the object of discerning which hens are infected, what is known as the "Agglutination Test" has been adopted. Blood is drawn from the hen, as described below, and tested in a laboratory. The claim is made that if she is infected that fact will be revealed by such test. She is termed a "reactor," whereas those showing no signs of the disease are "non-reactors." One such test, however, is not enough. Hens have been known when tested

at three months intervals to give opposite results. The process is expensive as the tests must be made by scientists. It is, therefore, chiefly valuable to breeders who can afford the cost. Although not altogether reliable, there is evidence that it has in some measure cleared stocks of this fell disease. The hope has been that immunity could thus be attained. That is doubtful in the extreme. Immunity may be merely individual, perhaps temporary, and that infection will recur unless environment and methods are totally changed.

The procedure is as follows (1) : The blood is drawn from a vein which will be found near the elbow (wing joint) of the hen. A few feathers should be plucked from the region of the vein, and the skin wiped with a weak solution of some antiseptic such as lysol. Prick the vein with a sharp needle—simply pushing the needle quickly into the vein. Allow the blood to drop from the injured vein into a (test) tube. When the tube is half full, sufficient blood will have been withdrawn. Place a small piece of cotton wool over the bleeding vein, and press the wing tightly against the body. The blood will stop flowing of its own accord in a very short time. Insert a stopper into the tube ; write the hen's number on the label, and keep the tube upright until the blood in it has become solid. Blood should be dispatched to the laboratories on the same day that it is withdrawn from the hen.

Coccidiosis.—Another disease which has become very prevalent is that now recognised under this term. It attacks chickens, as a rule after they are four weeks old, and in some instances very heavy loss has taken place. It is recorded also that in America, pullets during the late summer and autumn sometimes are attacked by this disease, although it is more slowly fatal. This would indicate that the chicken had carried the parasite but that in the early stages it was able to resist its attack. So far as research has taken place, it would appear that the disease is caused by an oval-shaped, single-celled, animal parasite, to which the name *coccidium avium* has been given. The home of the parasite is in the intestines. The disease is spread by the manure from infected birds, and it is claimed that it is greater during rainy weather and where the conditions are insanitary. The parasite is found in the intestines where it preys upon the mucus membrane of the duodemum or the caeca. It is suggested that bad systems of feeding and lack of

exercise, as a result of which the intestines are clogged, lead to development of this disease. The symptoms are not dissimilar in some respects to those described under Bacillary White Diarrhœa, namely, that the chickens are weakly, lose appetite, are pale in comb and wattles, rough in plumage and often show signs of leg weakness. What, however, may be taken as the most important symptom is that the diarrhœa is tinged with reddish-black blood, which is probably due to inflammatory action. So far as known there is no cure and birds should be destroyed. As the parasites appear to harbour in the soil, all other birds should be removed on to fresh soil and that occupied not used again for a year. The main object should be to prevent causation by proper methods of feeding and hygienic conditions.

Healthy Stock.—It is evident that, whilst conditional influences are powerful factors in causation and prevention of disease, in a large number of instances infection is transmitted by one bird to others. The introduction of a diseased specimen which may not be suspected, is frequently the immediate cause of outbreaks in one form or another. Exhibitions, markets, and auctions, are responsible for a large amount of disease among poultry, as is the practice of using old crates and hampers which have not been disinfected, and which by their structure provide harbourages for bacteria and parasites. Rigid attention should be paid to this question. An infection may be dormant, however, and cannot be perceived, revealing itself as a result of change of conditions. It is important to note that the introduction of a diseased bird to a flock will be harmful to the degree that the poultry with which it is brought into contact are in a state of body favourable to infection, otherwise the bacteria or parasites are impotent. It has been stated that a perfectly healthy man can serve in a cholera hospital with the minimum of risk. Such fact explains why some birds and flocks escape, while others readily fall victims to epidemic and other forms of disease. Unless and until measures be taken to prevent disease at the source by breeding from healthy stock, kept under sanitary conditions, and fed sanely, the dangers of epidemic and other diseases must be considerable. All newly introduced birds should be isolated for at least two weeks before they are permitted to mix with the other stock. By doing so, time will elapse sufficient for any latent disease to declare itself. All birds dying of disease should be destroyed

by fire or quick lime, to prevent spread of contagion, and not be buried.

Use of Serums.—The late Louis Pasteur during his investigations into chicken cholera in France, recommended inoculation of healthy stock as a preventative. The same course has been adopted in other countries, and with a considerable amount of success. For a time the birds so treated appear to be immune. As a means of dealing with outbreaks when these occur, and of limiting their scope, such treatment has proved very valuable. As a permanent protection, it cannot be depended upon. The labour and cost of inoculating all fowls on each farm in a district two or three times every year, without which it appears to be useless, would be very great. What must be sought for are methods of prevention, applying these generally.

Symptoms of Disease.—The symptoms of many affections from which poultry suffer can be diagnosed without difficulty. Among these may be included attacks of internal and external parasites; diseases affecting the nervous system, the skin and comb, the crop, the limbs, the oviduct, the digestive organs, and accidents. In respect to these a mistake can hardly be made. With diseases of a more complex nature it is found that the same symptoms may be indicative of several distinct diseases. That is especially true in respect to temperature, breathing, appearance of the plumage, and the evacuations. To some extent, it is alone by careful study of all the symtoms in combination that a guess—and it is often nothing more—can be made by the keeper of poultry who is not a trained pathologist, as to the nature of the disease. With the more serious affections a correct diagnosis is seldom possible until the later stages, or after death, when a post-mortem is made. It is of great importance that there should be such examination, which is described below, so as to reveal the cause, as far as that is possible, and thus lead to measures for prevention.

The following table (2) will indicate what are the symptoms of various diseases:

Symptom.	Diseases which Symptom named may indicate.
Abdomen swollen	Peritonitis, dropsy, white diarrhœa.
Belching of gas	Inflammation of crop.

Breathing abnormal—i.e., too rapid, too slow, snoring or wheezing, whistling, or in any way different from normal.	Diseases of the respiratory system, arsenic poisoning, pericarditis, gapes, Air-sac mite.
Choking	Arsenic poisoning.
Comb pale	Tuberculosis, dropsy, Air-sac mite, infectious leukaemia, white diarrhœa.
Comb first pale, later dark ...	Enteritis.
Comb very dark	Liver disease, blackhead, congestion of lungs, pneumonia.
Comb yellow	Liver disease, visceral gout.
Comb with white powdery scurf	White Comb.
Constipation	Simple constipation, indigestion, inflammation of oviduct.
Convulsions	Arsenic poisoning, copper, lead, or zinc poisoning, epilepsy, "harvest bug."
Cough	Diseases of the respiratory system.
Crop enlarged and hard	Crop-bound.
Crop enlarged or soft	Inflammation of crop, enlarged crop, gastritis.
Diarrhœa...	Diseases of the alimentary tract, arsenic poisoning, copper, lead, or zinc poisoning, blackhead, tuberculosis, cholera, roup, white diarrhœa.
Nostrils, discharge from ...	Diseases of the respiratory organs.
Emaciations	Tuberculosis, aspergillosis, visceral gout, mites, white diarrhœa.
Eye, expansion of pupil ...	Arsenic poisoning.
Eye, sticky discharge from ...	Catarrh.
Face swollen	Roup.
Droppings, bright emerald green	Cholera.
Fever, marked	Peritonitis, aspergillosis, infectious leukaemia, Inflammation of oviduct.

Lameness	Tuberculosis, aspergillosis, rheumatism, scaly leg, bumble foot.
Legs roughened, with scales raised	Scaly leg.
Mouth, mucous discharge from ...	Congestion of the lungs, pneumonia, gapes.
Mouth, white cheesy patches ...	Roup, canker.
Nausea and vomiting	Inflammation of the crop, copper, lead, or zinc poisoning.
Neck bent backward	Strychnine poisoning, congestion of the brain, wry-neck.
Neck limp	Limber-neck.
Paralysis	Copper, lead, or zinc poisoning, strychnine poisoning, apoplexy, heat prostration.
Saliva, copious secretion of ...	Arsenic poisoning.
Skin puffed out in blisters ...	Emphysema.
Skin scaly and encrusted ...	Body mange, favus.
Staggering	Congestion of the brain, leg weakness.
Thirst excessive	Hypertrophy of the liver, peritonitis, aspergillosis, tapeworm.
Tongue hard and dry	Pip, disease of the respiratory organs.
Tumours on head	Roup, chicken pox.
Urates yellow	Cholera.
Vent, mass of inflamed tissue projecting from	Prolapsus of oviduct.
Vent, skin inflamed	Vent gleet.

The fact of a bird being sick can generally be discerned by its appearance, respecting which the work referred to (2) says: 'A sick fowl is usually quiet, and does not move about unless disturbed. It stands or sits with the neck contracted, so that the head is pulled well into the body, giving the bird a "humped-up" appearance. The eyes are often closed, entirely or partly, giving the bird a sleepy appearance. Often the feathers are roughened, and stick out all over the body. The comb and wattles may be dark, or, on the other hand, may be very pale.' Constant observation should be kept on the flocks of poultry, at once removing any that are seen to be sickly.

A hospital for isolation should always be provided where the numbers warrant such an arrangement.

Post-Mortem Examinations.—Immediately on the outbreak of disease which has the appearance of becoming epidemic, steps should be taken to isolate all that are affected. Advice may be obtained by application to the various Ministries or Departments of Agriculture in most countries. It is, however, desirable that the poultryman should be able to make a post-mortem examination. The following description was published some time ago in the English paper *Poultry*:

'Let it be understood that a very large number of poultry which die are victims of some simple complaint, such as enlargement of the liver or tuberculosis in the lungs. These complaints are easily recognisable, and there is no reason at all why any farmer or amateur poultry-keeper should not be able to form a general opinion as to whether his poultry are dying from some such complaint as one or other of these. Take the dead bird and lay it on a wooden table, or on a piece of strong board, breast uppermost. Spread out the wings and the legs, putting a small nail through the joint of each wing and through the centre of each foot. It is not necessary for the bird to be entirely plucked; it will be enough to pluck the breast, and when this has been done pinch up the skin at the point of the breast bone, and cut it straight through, from the vent to the crop. Having done this, draw back the skin on both sides, so as to leave the flesh fully exposed, and then with a sharp knife cut through the flesh on both sides the breast bone, and with a strong, blunt-pointed pair of scissors cut out the centre of the breast-bone entirely, taking care in doing so not to injure the heart, as a flow of blood from the heart will interfere with subsequent operations. When this has been done, the principal organs will be seen clearly exposed.

'First of all examine the liver. To be perfectly healthy it should be of a rich chocolate-brown colour, free from any specks, and from any discoloration (although there are sometimes post-mortem discoloration at the edges, which are easily recognisable). If the liver contains any specks it is unhealthy, as it should not be what is known as "pasty" or "rotten." Healthy and firm to the touch, and of the proper colour, is the general description to apply to the liver. The heart should then be looked at, and it should also be quite firm, free

from any excessive covering of fat, and also quite free from any little nodules of tuberculosis. Another thing about the heart is that it should be even-lobed—that is to say, it should not be distended on one side and empty on the other; if it be so the probability is that the bird has died from heart failure, and, supposing it is known that the bird died suddenly, this can at once be accepted as the cause—syncope, failure of the heart's action, which always ends in sudden death, the bird dropping down dead without any warning. The lungs, which will be seen on either side at the back of the heart, are spongy-looking bodies of a pink colour. If a piece of one of the lungs can be cut off and placed in a bowl of water, it should float, not sink, or it will be unhealthy. Always look at the lungs for tuberculosis, which is usually to be detected there, and is indicated by little cheesy nodules in the substance of the lungs, which cannot possibly be mistaken; sometimes the lungs and the heart will all be eaten by these tuberculosis masses. If no disease has been found so far, proceed to examine the crop and the gullet, also the wind-pipe. With regard to the crop, it might also be examined first, if it is full of food, and apparently in a stage of congestion, to see whether there is a stoppage in the opening from the crop to the proventricle. The gullet and windpipe can also be examined to see if there is anything unhealthy about them. Similarly, an examination can be made of the intestines, and, in the case of a hen, the egg organs can be carefully dissected, to see whether there is a broken egg, or any egg substance has escaped into the cavity of the abdomen and set up inflammation.

'There is no difficulty about making an examination of the skull, and the amateur, with a little practice, will very easily be able to do this. The way to do so is to start at one corner of the mouth, and with a pair of sharp-pointed scissors cut around the skull to the other corner of the mouth; it will then be quite an easy matter to lift up the skull from the back, and the brain will be clearly seen. This should be perfectly clear, and if there should be any trace of a slight effusion of blood, it will be positive evidence of an apoplectic seizure, and will confirm the symptoms, which are delirium, resulting, after a few hours, or a few days' helplessness, in death.'

Parasites.—Of parasites there are many forms. The conditions where poultry are kept under domestication lead to their rapid in-

crease. There must be regular attention to hygiene and cleanliness to check their multiplication as they prey upon the birds. Professor F. V. Theobald, M.A., writing in the *Journal of the Board of Agriculture* of England, makes the following suggestions:

'Infestation is always worst in dirty and neglected runs and roosts, and such as are a standing danger to more cleanly neighbours. Cleanliness and freedom will always put these pests under a disadvantage—not only cleanliness of the nests, walls, and floor, but also of the ceilings and perches. To suppress these pests, the houses should be cleaned down at least twice a year with a wash made of lime, sulphur, and soft soap, the ceilings, walls, and nests, having a good coating. The wash should be fairly liquid, so as to run into every crack and crevice. (It can most easily be applied by a spray, of which there are many sold. E.B.) Early spring and autumn are the times for these applications. The perches are best treated with boiling water and soft-soap, or with an emulsion of kerosene or creosote. The latter insecticide is most beneficial, especially in regard to mites.

'Special attention should be paid to the nests; they should be frequently cleansed and changed to keep off fleas and other parasites. Neither nest-boxes or perches should be fixed; relays of each should be at hand, so that they can be changed to insure complete disinfection. The nest boxes should be now and then cleaned out, and dressed with hot lime and sulphur, or with a solution of corrosive sublimate. Either dusting the prepared nests with Persian insect powder or putting a little sawdust and sand soaked in naphthaline at the bottom will keep off these depredators. Wood shavings or wood-wool in the nests instead of straw is most beneficial. No lice or fleas will live in it, owing to the aromatic odour given off from the wool. Care, of course, must be taken that the remedies employed do not affect the eggs in the nest.

'Regarding the infestation of the birds themselves, white precipitate seldom fails. The heads and necks of young chicks should be early dressed very sparingly, and repeated when necessary. White precipitate is a strong irritant poison, and needs the greatest care in its use, especially in young chicks. It is best obtained as an ointment from the chemist's. Hens selected for sitting should have a small quantity of this ointment rubbed in under the vent, head, and sides, and then be well dusted with insect powder. Sitting hens are

greatly tortured by parasites, and their young are often lost by neglect of these simple precautions. The skin should be first moistened with soft-soap and water prior to dusting the birds with insect powder (pyrethrum). Some breeders prefer flowers of sulphur. Dust baths are the natural remedy for lice and mites, and fowls should never be kept without them. Sand mixed with a small quantity of creosote will generally keep the birds free from vermin. Finely-divided gypsum mixed with a small quantity of paraffin or carbolic is still more successful for these dust baths, quickly getting rid of any lingering pests that the birds cannot reach.'

Simple Affections.—The more serious diseases are usually too far advanced for curative measures to be adopted. In many instances mortality is very great, and it is often necessary to kill all stock which have been exposed to contagion. Below are named a few simple ailments which are more or less local, and in which treatment may be attempted by the poultryman:

Crop-Bound.—If green food be denied for a time, and then given in unlimited quantity, the fowl will at times eat to repletion. As the crop is unable to deal with this mass of undigested food quickly, it becomes hard, and not only cannot pass to the stomach, but impedes the way for other food. New grain may also be a cause, due to its swelling in the crop, forming a mass, or by the presence in the gullet of a twig or some other hard substance. The proof of a crop becoming bound is purely external. Instead of the organ having a firm, close appearance—in fact, not being seen—it hangs down like a bag, and the ball of contents can be felt. If the trouble is discovered early, cure is comparatively easy. The primary step is to pour a dessert spoonful of salad oil or melted lard down the throat, and then work gently the crop contents with the hand. This, if properly and effectively done, will cause the mass of food to be broken up, softened by the oil, and in the course of a few hours it passes away.

When the kneeding process is ineffectual an operation becomes necessary. In the upper part of the crop a lengthways incision, about 1½ inches long, should be made through the skins with a very sharp and sterilised knife or lancet. Through the incision the contents of the crop should be removed, using for the purpose an egg spoon. Sometimes the mass is so hard that it cannot pass through the aperture,

in which case it must be gradually broken up, which can be accomplished by patience. The mass is sometimes very offensive. To remove any contaminating matter which remains, the crop should be washed out with warm milk and water, or any non-poisonous disinfectant. The finger, well pared and oiled, should be passed into the lower orifice, so as to be certain there is no obstruction of the oesophagus, otherwise the process will not be effective. This done, the incision is sewn up, for which a small bent needle should be used, as by it the two skins can each be gathered, as these are sewn separately, using white silk or horsehair.

Soft-Crop.—When the crop is distended without any mass of food, this is due to a surcharge of water or air in the crop, possibly from inability of the organ to perform its functions. The contents may be expelled by turning the fowl upside down, pressing the crop by the hand. If that does not effect the purpose, it is necessary to puncture the crop, using a coarse darning needle. Such incision will not need to be stitched. Birds so affected should be isolated, and fed three times a day until normality is reached on toasted bread steeped in milk.

Soft Eggs.—One of the earliest derangements of the egg organs is indicated by the laying of eggs without shells, which may be due to lack of calcareous material. That is easily remedied. As a rule the cause is generally over or improper feeding. Stimulation of the egg organs leads to inability of the hen to retain the egg until coated with the shell envelope. Laying for a time must be checked under these conditions by feeding upon plain food, and by the giving of an aperient. For the latter there is nothing better than a pill composed on 1 grain of calomel and ½ a grain of tartar emetic. A little iron may be added to the drinking water as a tonic. Soft eggs are sometimes caused by the hen being frightened and is merely incidental. At times it is found that the presence of an irritant in the oviduct causes this trouble, and when that is so, a dose of castor oil or medicinal paraffin will be effective.

Egg-Bound.—Under these circumstances the hen cannot lay her egg which blocks up the oviduct. The cause may be contraction of the passage, or abnormal size of egg. The symptoms are a frequent visiting of the nest without any result, and a depression of the wings and tail,

the bird showing signs of distress. Should the egg be very large, the first step is to soften the vent with pure salad oil. If that is ineffective, an ounce of the same oil should be injected into the vent an hour afterwards. Care must be taken not to break the egg, which would probably be fatal to the hen. In obstinate cases doses of a tablespoonful of warm treacle, or molasses, in which some chopped groundsel is mixed, may be given, or the hen may be held with its vent over a jug of boiling water, in which 10 drops of iodine to a quart of water is added. This steaming of the organ usually gives relief. When the egg is normal in size contraction of the passage is indicated, and is usually accompanied by inflammation. Under those conditions steaming of the vent is most effective. When relieved the hen should be isolated for a few days.

Leg Weakness.—One of the most troublesome affections of young chickens, more especially those which are artificially hatched and reared, or raised under intensive conditions, is a failure of the legs which prevents the birds moving about, these squatting on the ground. If not treated at once, the joints become stiff, the toes curl up, and, when there is an attempt to walk it can only do so on its leg-joint, which, soon, from the friction, become enlarged and worn in the skin. This weakness may be caused in various ways. Very often it is due to a more rapid growth of the frame than the legs are able to bear, and when that is the case no one can be blamed for it, as climatic influences may have been at work that could not be foreseen. Too frequently it is the result of forcing, or of a wrong system of feeding. It is most important that in all efforts to obtain size the development of both frame and flesh should go on at the same time.

Recent investigations have, however, revealed the fact, which was not previously known, that leg weakness can, to a considerable extent be prevented by giving the birds as much sunlight as is available. This has opened a new field of inquiry. It at once indicates that there are forces in nature which can scarcely be measured but which are essential to complete development. Under certain conditions, something can be done by application of ultra-violet rays. More important, however, is it that provision be made in houses where chickens are being raised, that these shall have open fronts and the whole of the floor space may be flooded with light, as that the birds should be

given access to the open air to the fullest extent, merely keeping them under cover when the weather is unfavourable. There may be other contributory factors which as yet are unknown. What is here stated is a further instance of how we must conform, even if it involves drastic changes of methods, to natural requirements.

Scaly Legs.—Yellow-legged birds are very subject to a form of elephantiasis, to which the name of scaly legs is commonly given. There are two forms of it. The one is due to the presence of a small insect on the legs, which is very contagious. The other arises from a deficiency of the oily secretion, thus causing the skin to dry up and split into divisions like scales. Both are easy of cure. For the parasitic form the remedy is, after washing the legs and scrubbing them with a nail-brush, to apply sulphur ointment. For the other kind a preparation made of equal parts of vaseline and zinc ointment, applied daily, will be the best remedy.

White Comb.—Generally due to overcrowding, to bad feeding, and the absence of green food. The comb becomes covered with scurf, which, if not checked, in process of time extends down the neck, and the feathers fall off. It is really a form of scurvy. When white comb appears, there should be immediate attention to the food, and a wholesome and liberal diet, pure water, grit for the assistance of digestion, and an abundance of vegetables, with strict regard to cleanliness. A good aperient should be given two or three times, and some sulphur mixed with soft food. The comb should be anointed with a little vaseline. The birds when cured should have a good tonic.

Worms.—Very often, when birds are troubled with worms, it is difficult to discover what is the matter with them. The chief or perhaps the only symptom noticed is that they mope or hang about. When worms are present, the safest and best proof is by an examination of the droppings, in which worms will generally be seen if the bird is so troubled. The cure is, happily, not a very difficult one. The best remedy, so far as our experience goes, consists of capsules of turpentine, one or two of which, followed in twelve hours by a dose of castor-oil, have always been sufficient to expel the troublesome parasites from the system.

Various Suggestions.—Egg-Eating.—How far the evil practice

of egg-eating is due to denial of something for which there is a craving, has never yet been determined. In many cases it is thought to be merely a bad habit, which perhaps has been learned by temptation of a broken egg, thus giving a desire for the contents. Unfortunately, this habit is quickly learned by other hens. Many suggestions have been made for treatment, some of which, such as paring the beak of the guilty bird, are not to be commended. Very often the cheapest way in the long run is to entirely remove, and even get rid of, any bird found eating her eggs. The following plan is sometimes found effective, a blown egg should be filled with a strong mixture of mustard and cayenne pepper, closing up the ends with gummed paper. Leave this in the nest, and, if the hen tries to eat it, she will obtain a dose she does not like, which may prove a deterrent. Sometimes, the habit is due to want of shell-forming materials, a supply of which will stop the trouble. Placing the nests above-ground and in a quiet place will generally prevent egg-eating.

Feather-eating.—Feather-eating is one of the most annoying practices that trouble the poultry-keeper, and is both difficult to account for and to cure. It arises, no doubt, from the want of something which the hens require, and which they are able to find for themselves in a natural state, for fowls with a wide range seldom show it. The want may be lime, or flesh food, such as worms and grubs, or the habit may be encouraged by the presence of insects in the feathers, which latter can be prevented by a dust bath. Those hens which are usually the culprits had better be removed at once, as the habit will scarcely be broken off if kept with the cock. Pluck the stumps of the feathers out of the cock, and wash the bare places well; then rub on vaseline or olive-oil, mixed with a tenth part of carbolic acid. Give the birds plenty of exercise by burying the corn and letting them work for it, and also hang a piece of meat or a cabbage by a string just where they can touch it, and so that it will swing about. Some bone-meal should also be given in the soft food.

Professor Theobald says: "There are two kinds of feather-eating—viz., 'self feather-eating, and the eating of other birds' feathers.' The former is entirely due to the mites living upon and irritating the roots of the quills, and, so far as is known, the latter is caused by the same acarus. The form on the fowls makes its appearance about April,

and is most prevalent in spring and summer. The mites can be easily found amongst the white, powdery matter at the base of the quill. The minute young are transmitted during copulation. The fowls pluck out the feathers to destroy the irritation caused by the mites at their base. *Prevention and Remedies.*—As the disease is contagious, isolation of the affected bird is the first step, especially if it be a cock. The mites readily yield to treatment with oil of cloves rubbed into the infected area. One part of creosote to thirty of lard or vaseline is still more successful."

Moulting.—The moulting of birds is an operation which usually takes place every year, and is the casting of one set of feathers and replacing them by entirely new ones. There is a constant change of, and growth in, the feathers all the year round, but only during the moulting season is there anything like regularity in the process. Moulting makes a considerable demand upon the system. Chickens hatched during the first four or five months of the year obtain their adult plumage about September or October; but this cannot be called a moult, and the first one takes place about the following September. Every year this becomes later and more protracted. Hence the plan advocated for laying fowls—namely, killing off birds before their first or second moult, when they are still good for table purposes, and before they have to be kept without any profit. That, however, is non-economic.

The time during which birds are moulting is a somewhat critical period, its nature depending very much upon the stamina and constitution of the fowl. There is a considerable amount of difference in the way which the various breeds come through the moult. Some of the hardier varieties pass through it both rapidly and easily, whilst others find it most protracted and difficult. The usual period of moulting for a strong bird in its first or second year is six to eight weeks, in which time the old feathers are completely cast, and new ones occupy their place; but it is no uncommon thing to find weak or old birds taking three months, with the result that winter arrives before they get through it, and they do not recommence laying until the following spring, so that several months are lost, and when the produce is most valuable. All that is necessary for healthy birds is to give warm food once a day, mixing in it some seasoning powder, and lean meat, with a little grain, such as buck-wheat and hempseed, in

the middle of the day. In the drinking water put a little sulphate of iron and sulphuric acid—say two pieces of the former, the size of nuts, and ten drops of the latter, to a gallon of water and, of course, this must be renewed every day, as fresh water is most important.

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